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THE ANALYSIS OF SUGAR AND MOLASSES.

[A TRANSLATION OF THE REPORT PRESENTED TO THE CENTRAL COMMITTEE OF THE SUGAR MANUFACTURERS OF FRANCE.]

(Continued from page 647, *vol. iii.)*

7. Polariscope.—We do not think it needful to enter into any theory of the polariscope; it would be useless or at least insufficient without going into a disquisition on the physical laws respecting light. Those who desire to pursue this study will find the subject in books on pure physics.

We will merely describe the polariscope and say in a few words how it acts.

It is formed of a sort of lunette placed on a stand, the end which is turned to the light when it is in use contains the various glasses which prepare the light, that is to say, polarize it. One part is composed of a moveable tube to contain the saccharine solution, through which we wish to pass the ray of polarized light. This tube should be exactly 20 centimeters in length.

The eye-piece end contains the glasses which serve to counterbalance the action which the sugar exercises on the polarized light, and the effort necessary to affect this,—by means of the greater or less thickness of two wedge shaped conical plates which are made to slide the one against the other,—is measured by a graduated scale, and thus the richness in sugar of the interposed sugar solution may be appreciated.

8. ESTIMATION OF SUGAR BY THE POLARISCOPE.—Weigh in a capsule which has been tared 16·35 grammes of sugar from the original sample (selecting it carefully and not using what has become dry), and dissolve in distilled water.

The simplest and surest method of dissolving the sugar is the following, in which there is no changing from one vessel to another which should always be avoided as much as possible.

Place on a flat bottomed flask graduated to 100 c. c. a glass filter, broad and short and with a wide funnel; throw into this funnel all the sugar at once, and wash it into the flask by means of a jet of water from a pipette; when all the sugar has passed through wash the sides of the filter in the same way. The capsule in which the sugar was weighed should also be rinsed, and the water put into the flask, which will generally be now about half full, the solution of the sugar may then be facilitated by giving to the flask a circular motion, rather than by shaking it up and down, using the finger as a cork, because the solution being less than 100 c. c. there is a risk of a loss of sugar, some of which in any case remains on the finger. When all the sugar is dissolved, add water in such quantity as to make up to 92 to 95 c. c.; fill up to the guage line with sub-acetate of lead, taking care to let it run down the side of neck in order not to form froth, as this would prevent the exact reading of the level line, which should correspond with the lower part of the meniscus.

Mix the whole by carefully stopping the flask with the finger and turning it up and down. It is necessary to mix long enough to make the solution homogeneous. Before filling the saccharometer tube it is necessary to rinse it once or twice with the filtered liquid, then fill it quite full and be careful in putting on the glass and stopper at the end that no air bubbles are enclosed in the tube.

Saccharometrical observation does not we think present nearly so many difficulties as is often pretended. It is however necessary that the proper method be employed and that great care be taken.

It will be needful here to enter into some details, but the length of these does not prove that observation is difficult, but simply that in order to be exact every necessary precaution must be taken.

It is essential in the first place to be sure that the polariscope s correct, that is to say that when the tube is filled with pure water the index stands exactly at zero. This proof is made exactly in the same way as an observation on sugar solution.

The tube being filled with water is placed in position, and the divided scale moved by the button in such a way that the index marks 5° or 10° to right or left of zero, then place the eye as close as possible to the eyepiece so as not to touch it, when the disc will appear of two colours which should be made as distinct as possible by turning a screw under the eyepiece. Then turn the button, which moves the graduated scale, towards zero without taking the eye away. When the two halves of the disc appear nearly uniform, turn the button very slightly from right to left and from left to right; it will be seen during these movements that the right and left halves of the disc become alternately a little darker and the movement being made gradually slighter either way, is at length stopped in the middle of the smallest distances which will make the feeblest difference in the two halves of the disc. At this moment read the scale, which we will suppose stands at zero; then recommence by modifying a little the two colours of the disc by means of the screw provided for that purpose, and see whether the differences obtained by the slightest movements of the button are more or less appreciable than before. If the new tint is preferred, endeavour to find the exact point again; if not, return to the first colour or to any other which may be produced by the alteration of the screw named, and again find by the movements of the button the exact point, and read the notation on the scale as before; if the operation has been well performed the same point will again be marked, viz., zero; if not it will be necessary to recommence and go through the same operations until exactly the same result is given more than once, which may be taken as correct, for it will not do to take an average between two different observations, as varied results only show in fact that the operator does not see well from some cause or other, and that the result is merely a chance one.

If on the other hand it is certain that the water marks 1° for example, it shows that the polariscope is not correct; it will then be needful without touching the button to turn the small screw to the right of the divided scale so as to move it to 0°.

The operations must then be recommenced as though taking the standard of water again, and if it is found to be exactly 0°, the instrument is correct.

It is necessary to be very careful never to touch accidentally the small screw which regulates the scale.

After having thus proved that the polariscope is quite correct and marks 0° with pure water, we may now make trial of the saccharine solutions prepared as above.

The observation is made precisely in the same way as for taking the standard of pure water.

We have nothing then to add if the colour which was the best adapted for the water appears suited to the sugar solution, or rather if the regulating screw being unaltered, the colour remains unchanged; otherwise it will be needful to try which is the best tint under the circumstances; this must be done exactly in the same manner as in the case of the assay of the pure water.

The degree marked on the graduated scale in centimes shows the quantity of pure sugar in the raw sugar under observation; if then the index points to 95° on the scale, the sugar in question contains 95 per cent. of pure sugar.

We have endeavoured to give in a direct manner the method to be followed in valuing sugar by the polariscope without encumbering it with directions or notes, which will however be of use to the operator.

We will now give in due order these supplementary instructions.

The polariscope may be turned either towards the sky, or towards a lamp. The lamp should be one giving a rather large white flame without vacillation, the end should be about 10 centimeters (3½ in.)

from the *middle* of the flame; because if the polariscope looks towards the side of the flame one of the two halves of the disc will appear less clear than the other, and this will be a cause of error.

It is not needful that the other part of the laboratory should be light, and especially there must be no other light than that of the lamp near the face of the operator; it will be better then that any other light needed for reading the graduated scale should be placed behind him and suitably screened.

The most convenient position for observing, is to lean on both elbows, cover one eye with one hand and turn the button with the other; this detail may seem superfluous, it is however very important, for if the body is unsteady or uneasy, the eye blinking, it is completely impossible to make an observation which can be depended upon; in a word it is necessary that the attention of the eye should not be distracted, nor the hand which turns the button be disturbed by anything whatever.

When the sun's light is used it is necessary to choose a white or pale blue sky, and the operator must be protected from diffused light just as though a lamp were being used.

We may note in passing, that according as the operator is short sighted or not, the distance of eye piece must be regulated with regard to the interior glasses, for this purpose the eye piece can be moved in its socket, and the operator in adjusting it will observe that the disc is larger or smaller according as it pushed in or drawn out, and that the two halves become more or less distinct, and he must choose a focal point which is best adapted to his eye.

We said in commencing that it is needful often to verify the zero of the polariscope, *i.e.*, whether water shows 0° on the scale; this precaution should be taken very frequently, but it is needful also at least once on first using a new instrument, to see that it not only marks zero on the scale with pure water, but also that it marks 100° with pure sugar, that is to say, with white sugar candy lightly powdered and dried in a stove at 100° C. (210° F.). If the saccharometer is correct, the standard of this sugar will be exactly 100°.

It is unnecessary in making this trial to use acetate of lead to purify the solution, but it is well to pass it through filtering paper.

Some years ago, one of our number proved the very curious effect of cold on his polariscope.

On this subject he wrote the following letter, which appeared in the *Journal des Fabricants de Sucre,* of the 4th of February, 1869:—

"A CAUSE OF ERROR IN POLARIMETRICAL ASSAY.

"I wish to notify a fact which has not I believe yet been remarked amongst the causes of error in saccharimetry:—

"When the polariscope is very cold its indications are incorrect.

"I was led to make the following experiment during this cold weather by some anomalies which I could not at first account for.

"The polariscope being in a room heated to the normal temperature of 15° to 20° Cent. (60° to 68° F.), the tube containing pure water and the index marking 0° on the scale, the disc consequently of a uniform clear lilac colour, I carried the instrument to the outside of the window without altering it in any way, in a time of frost, having, it will be understood, just removed the tube, as it is not the temperature of the liquid of which the action is noted.

"In a quarter of an hour I took the cold polariscope, replaced the tube, and again observed. All was changed: in place of a uniform lilac tint the disc was of two distinct colours, yellow to the left and green to the right.

"I then placed the polariscope on the chimney-piece and waited half an hour; the disc had then returned to its uniform lilac tint. I have made the same experiment more than twenty times with the same result invariably. The same phenomenon was produced, but more slowly and not so marked, in making an assay alternately in a heated room and in one without a fire, where the temperature was at 0° or 1° C. (32° or 33° F.) for example.

"In seeking to establish a uniformity of tint whilst the polariscope is cold, it can only be done partially, towards 5° or 6° of the scale, and the two halves of the disc are not quite of the same colour: the part to the left always retains a yellow tint, and when turning the button from right to left the change is not nearly so marked as usual.

"When there is in the tube a liquid (saccharine or other) of a slightly yellow colour, this cause of error is still more dangerous, more treacherous, so to speak, because it is less apparent, and the yellow colour given to the left of the disc by the cold is confounded with the natural tint of the whole, and may allow of the establishing of a uniformity of tint, but with gross error.

"I have in fact experimented with a solution of sugar mixed with a little molasses, which in a heated room marked 80°, and, after allowing the polariscope to become cold, in a room where the temperature was 1° Cent. (33° F.), I found it marked 82°.

"It is then very important in winter, only to make saccharometrical observations in a warm room, and to wait in the morning until the instrument has recovered its normal temperature before using it."

Our colleague never received any observation or reply to this letter; he made similar experiments in the following year with like results, and he discovered that it was the anterior part of the polariscope, that of the eyepiece, which is thus influenced by cold.

The frost ceased before he was able to procure another polariscope, to see whether the phenomenon was peculiar to his instrument; but this would be very surprising, as his is a very good one, of the newest make, never out of order in ordinary weather. Whilst then it may be admitted that all do not act in this way, there may be a certain number in same case. We would then recommend those who make saccharometrical experiments not to take this phenomenon on trust, but to make the experiment for themselves.

The method which we have already pointed out of clarifying or defecating sugars for saccharometrical assay, is generally sufficient; sometimes however when the sugars are very dark coloured it is necessary to use a little more acetate of lead, care being taken to leave a little more room in the flask so as not to have a greater volume than 100 c.c.

If the solution is not yet sufficiently decolored, it will be necessary to filter it through new charcoal, but in this case it may be needful to make the assay with double weight of sugar, say 32·70 grammes dissolved in 200 c.c., including the acetate of lead, as the first filtered portion (at least equal to the volume of charcoal used) must be rejected because the density is altered.

Sometimes a better decoloration may be obtained by adding a little tannin to the sugar solution, before the acetate of lead.

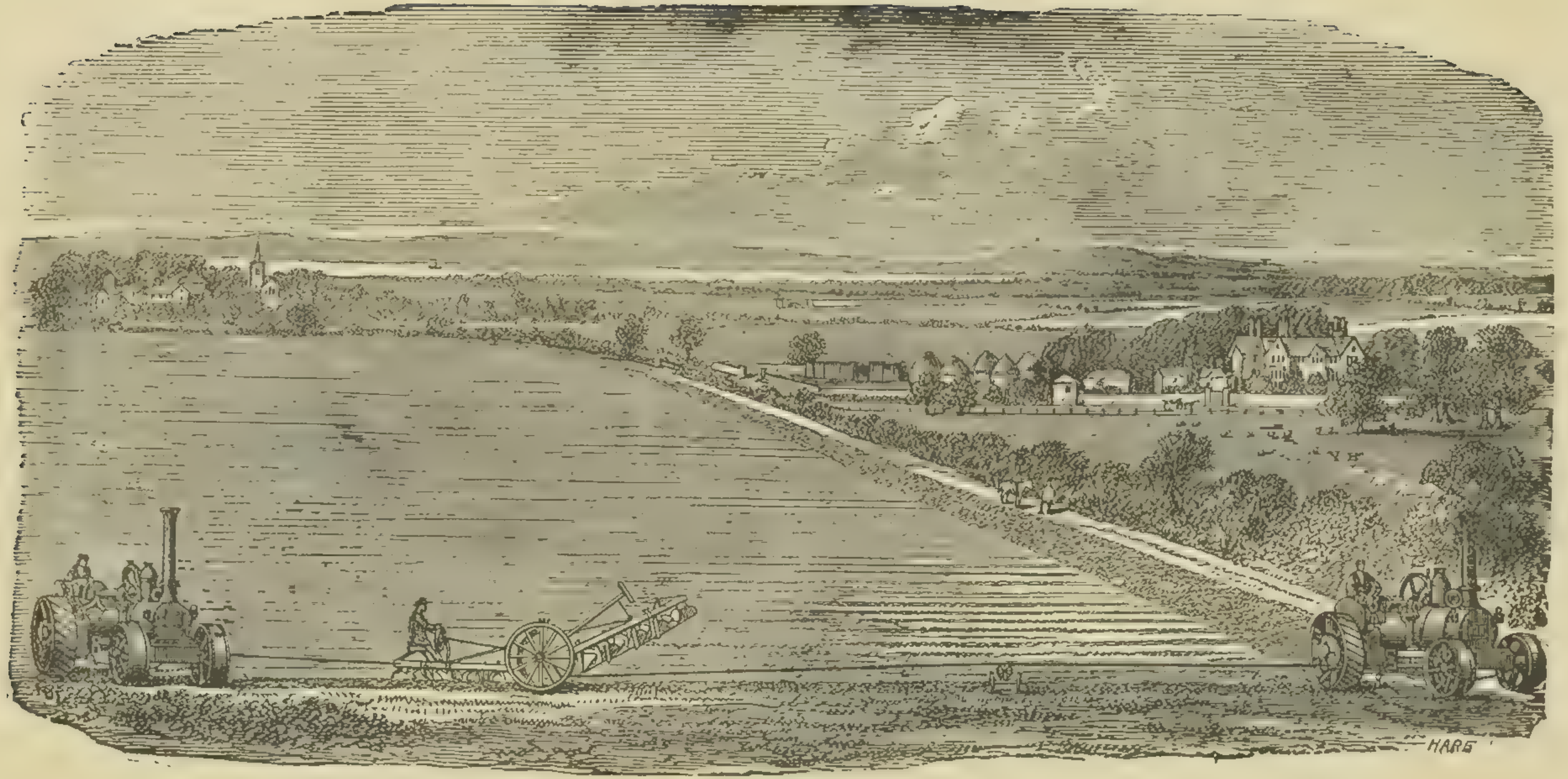
In conclusion we must add that it is well to verify the density of the sub-acetate of lead which is employed; it should be at least 32° by Baumé's areometer.

(*To be continued.*)

THE MANUFACTURE OF CANE SUGAR IN THE COLONIES.

Although at the commencement of this treatise we disclaimed any intention of interfering with the agricultural portion of the subject, innovations of the greatest importance, viz., steam cultivation and steam carriage, have of late years been so extensively adopted, that a short description of the various methods may not be out of place. Tha original style of cultivation—and one which is still extensively in use—was to prepare the ground for the reception of the cane plants by means of hoes. Where labour is very abundant, and consequently very moderate in price, this system is yet carried on profitably, but we believe even in these exceptional cases it must eventually be superseded by steam cultivation. The most usual plan at the present time is to prepare the land by means of ploughs, as the price of labour does not admit of hand hoeing, the ploughs being drawn by cattle. Anyone, however, who has watched this method must have been struck with the laborious slowness of the process, two "spell" of cattle being generally required to draw a single plough at the rate of about one and a-half miles per hour. It is true that in some favoured spots, where an active young elephant may be obtained for a moderate price—say forty pounds—the land can be prepared both quickly and cheaply; but these cases are so exceptional as to require no further notice. The great success of steam ploughs—notably those manufactured by Messrs. John Fowler & Co., of Leeds—for agricultural purposes in this country, attracted the attention a few years ago of some enterprising planters in South America, who very justly considered that if such a system were successful in England, where there is an abundance of labour, it must be still more advantageous for a sugar estate where labour is scarce and inferior. The first essays, however, were not very successful, and it soon became evident that the implements in use in England and on the Continent were unsuited to the requirements of a cane-piece. To anybody who knows anything about a cane field this will not appear at all surprising, as the difference between the cultivation of corn and canes is obvious. The distance between the rows of canes varies considerably in different countries and with different species of canes, but it may, we believe, be fairly set at six feet, the plants being placed about three or four feet apart. To open up the ground for this description of planting a very powerful plough is required, together with engines and tackle in proportion. These requirements have now for some time been supplied by Messrs. Fowler, with, we believe, very satisfactory results, the entire machinery having been remodelled for that particular description of work. The usual style of working is shown in Fig. 1, where it will be seen that two engines supplied with winding gear beneath the boilers are worked on opposite headlands, each alternately drawing the plough towards itself, the engine not in work paying out the rope, and at the same time moving forward into position for the return of the implement.

Fig. 1.



The plough which is illustrated by Fig. 2 is not required to turn round at the end of the journey, as the one set of shares upon which the driver sits is in operation during the journey in one direction, and upon arriving at the end he has only to change his seat to be ready for the return journey for the other set. These ploughs are made very much stronger and larger than those usually employed in this country, in order to suit the requirements of the peculiar cultivation necessary for sugar canes.

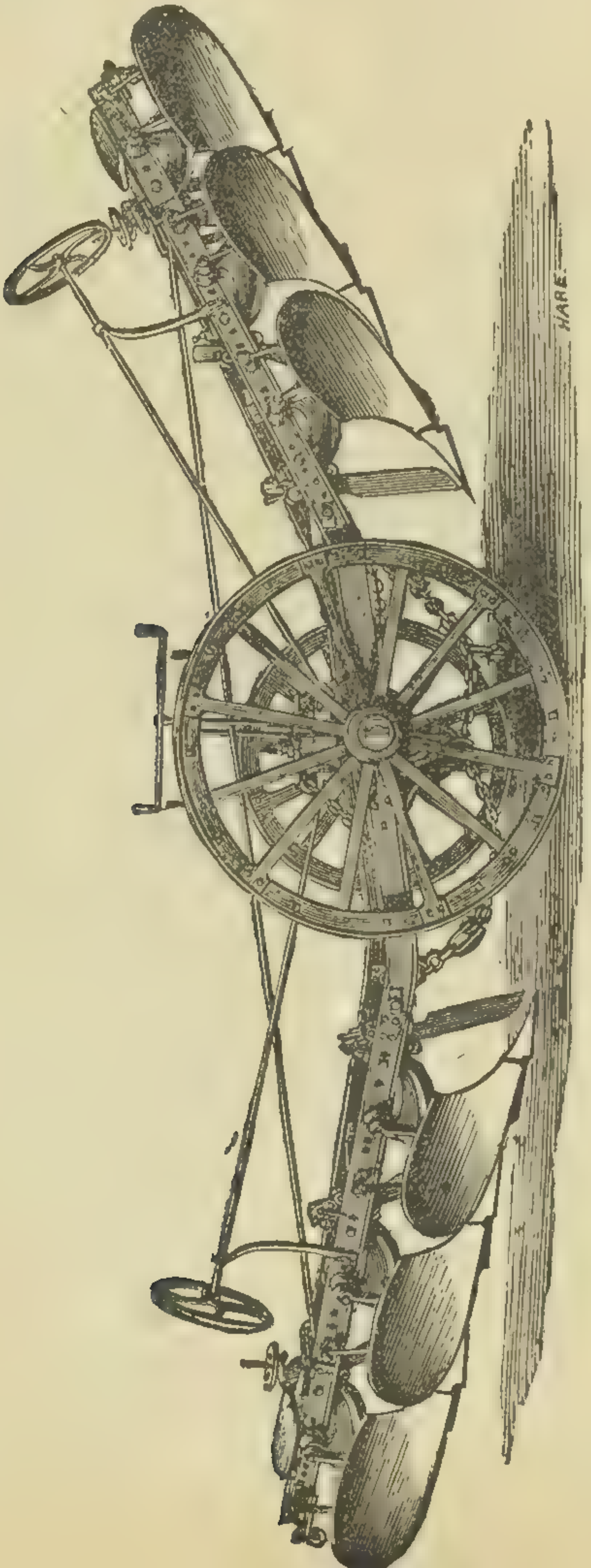


Fig. 2.

Another powerful implement, shown in Fig. 3, is exceedingly useful for opening wide drainage or irrigation ditches, and is very useful for estates situated upon low lands. By means of these ditches, run in rows every twenty or thirty feet, between the canes; they may either be drained rapidly during wet weather, or irrigated in the dry season with the greatest facility.

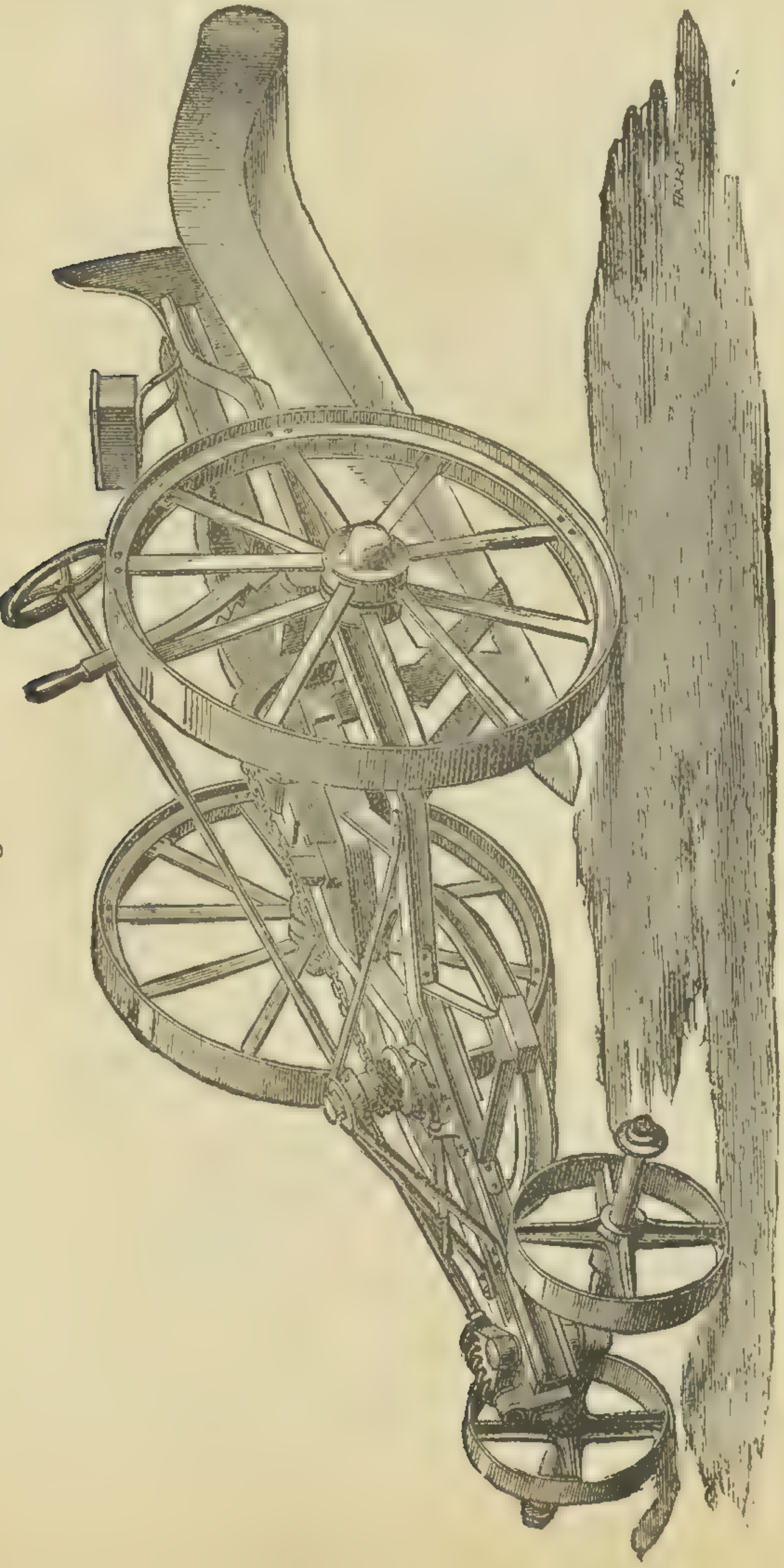


Fig. 3.

Another very ingenious implement may be used, when the soil is not too heavy, for breaking up the land. This is called by the patentees a "turning cultivator," and is represented in Fig. 4. This implement is especially adapted for being worked by the double-engine system illustrated in Fig. 1, as it is so arranged that it can be turned round by the engines after travelling to the end of its

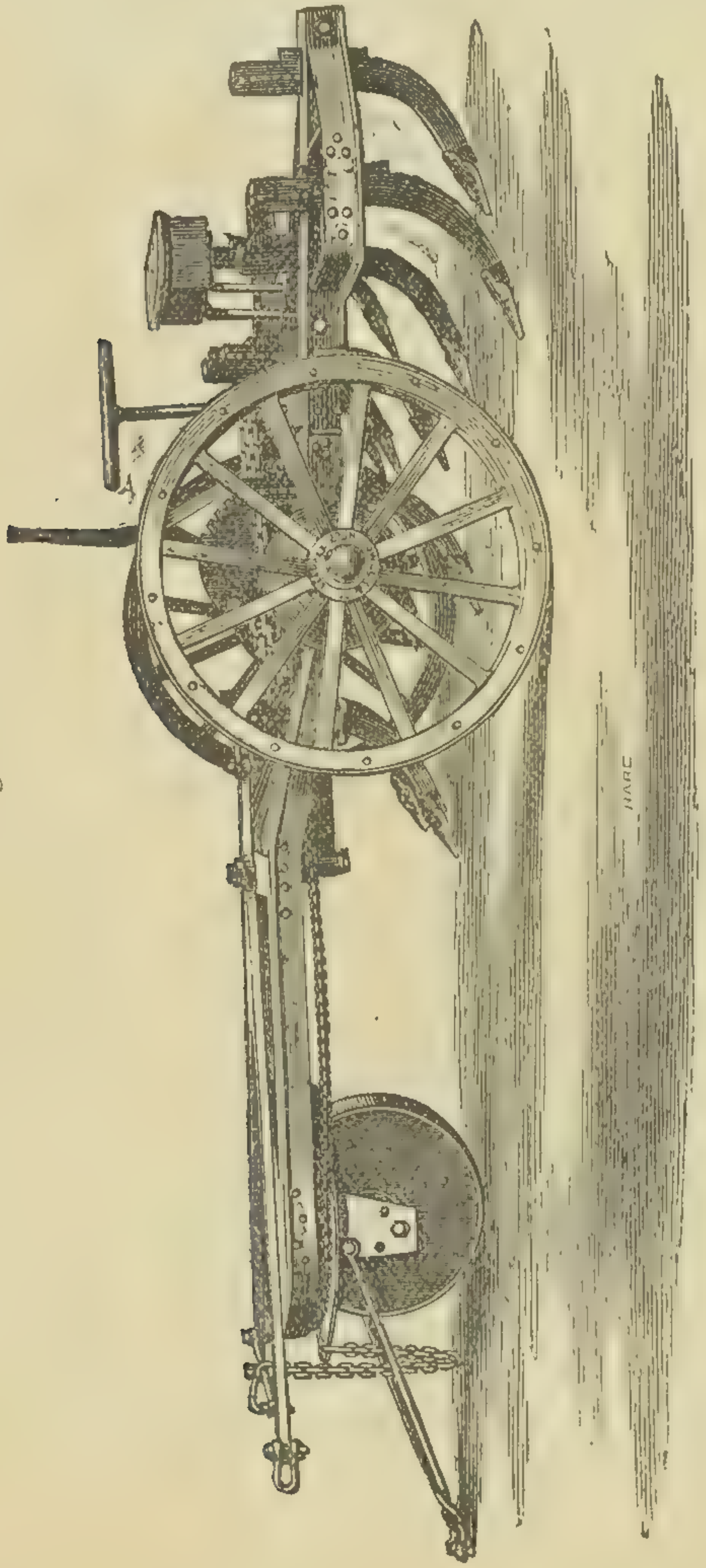


Fig. 4.

journey in one direction so as to be ready at once for the return journey. It consists of a strong iron frame, carrying according to circumstances from five to thirteen tines, and resting on three road-wheels, the front wheel being the steering wheel. The axle of the two hind wheels is cranked, so that, by its being turned the frame is lowered or raised, and by these means the depth of the tines adjusted. The long end of a draft bar, or "turning lever," is provided with two arms to which the ropes of the two engines are attached. The arms are set at an angle, for keeping the tail rope clear of the implement. The lever itself is held by a vertical stud fixed to the frame, considerably behind the steering wheel. This position of the draft stud, gives the necessary liberty and power to the steering wheel, and enables it to lead the implement at almost any angle out of the line of the pulling rope. On the short end of the turning lever is a chain communicating with a quadrant on the crank axle, and as the lever is pulled round the chain acting on the quadrant turnes the axle, lifts the frame, and raises the tines out of the ground. The plan of operation is as follows:—As soon as the Cultivator is brought up to the headland, the engine on the opposite headland begins to work, and pulling the lever round, lifts the tines out of the ground, which are held up by a catch; when lifted the required height, the lever strikes against a stop and pulls the implement round into new ground; the man (who never leaves his seat) releases the catch, the tines drop into the ground, and the implement is drawn across the field.

The principal advantages of this excellent implement are as follows:—Its size is only limited by the power of the engines, which thus may be used to their utmost capability. It smashes up the soil, working steadily, and always preserving a perfectly uniform depth. Even the largest implements of this description require only one man in attendance. In turning round, no additional work whatever is required, and scarcely any time is lost, whilst the implement, however wide, at once moves into new land, leaving small and clean headlands. On average soil 30 to 50 acres per day may be efficiently cultivated. Ridging bodies attached to the frame of this cultivator will produce a most effective and easily-handled ridging implement.

For working up new land when stones, roots, and other natural impediments occur a very powerful grubber may be used with advantage; the implement being driven with the same machinery as that described above. This grubber which is illustrated in Fig. 5

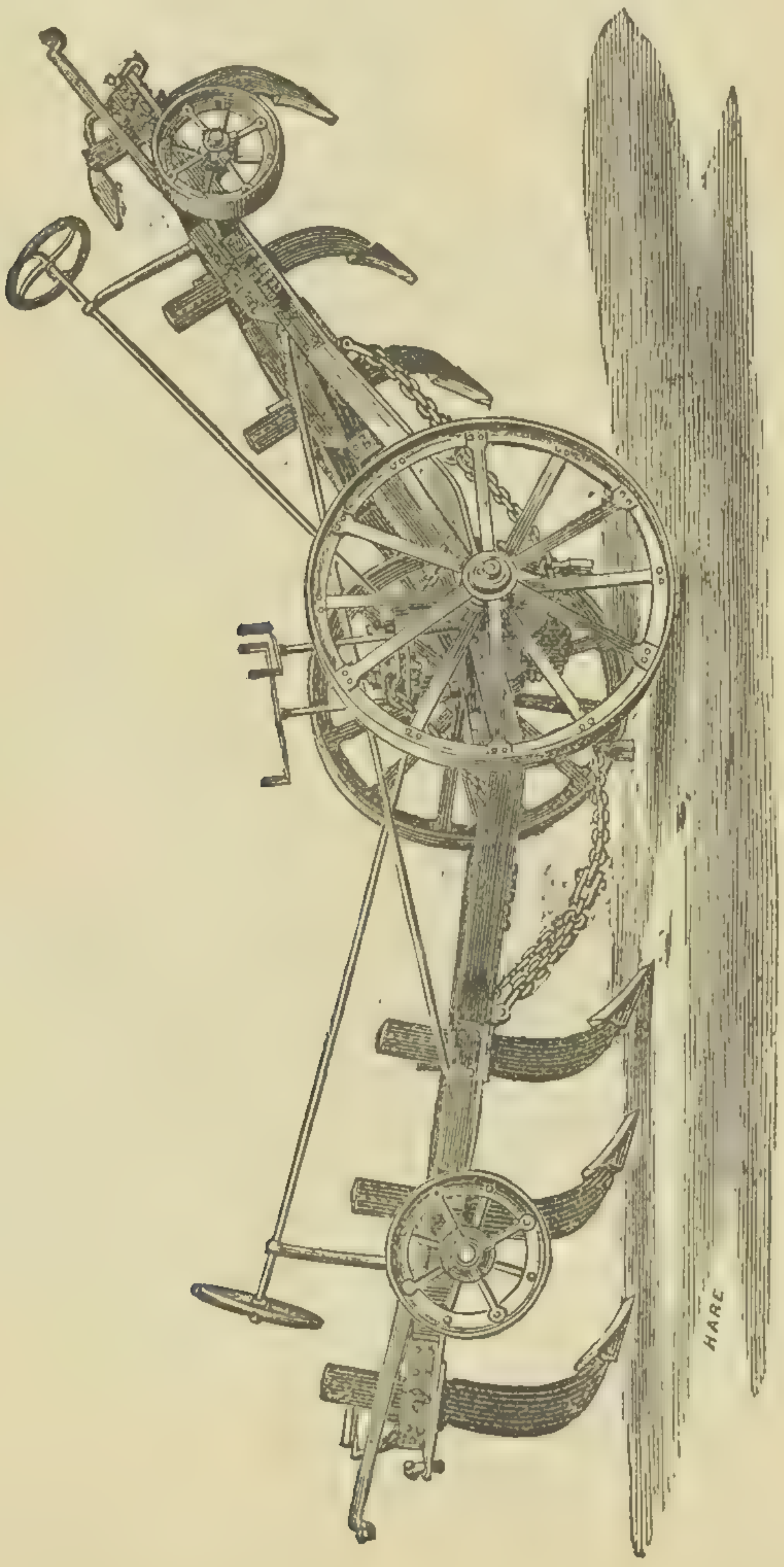


Fig. 5.

is a remarkably useful implement for thoroughly and speedily clearing land. Its power is enormous, defying almost any obstacles that may present themselves and at the same time the depth (2ft. 6in. to 3ft.) at which it works thoroughly aerates the ground.—*The Artizan.*

THE USE OF BI-SULPHITE OF LIME IN LOUISIANA.

The following notes on Sugar Making, from the *Louisiana Sugar Bowl*, are by a planter in the country who, we are told, is well known as one of the most successful sugar boilers in the State.

As an account of the method of using Bi-Sulphite of Lime by a practical planter, the information contained will be interesting, and, perhaps useful to many of our readers:—

"As cane juice possesses the same properties as the soil upon which it grows, it will be necessary for the sugar boiler to first examine the soil that his cane grows on, that he may detect the impurities that his juice possesses. The purest juice is obtained from cane that grows on sandy woodland with clay subsoil, when not too new. The most impure is obtained from cane that grows upon stiff prairie with gravel subsoil, (this gravel being carbonate of lime); the alkali is held in solution in such quantities that it precipitates the other impurities to the bottom of the kettles, and produces the following consequences: gray sugar, dirty kettles, an excess of molasses, and double work.

"The juice from new woodland cane contains a great deal of acid and albumen. These three impurities—alkali, acid, and albumen, are all that we have to contend with in cane juice, in the open kettle process. Lime in the *Grande* does not assist the dirt to rise as is generally supposed, but the reverse, if added when the juice is cold. The purer the sugar is the less deliquescent or volatile it is, for those impurities are the only causes that produce this dampness. Two of these remain in most of our common sugars. The juice from stiff soils where there is any gravel in the bottom of the ditches will contain such a quantity of alkali that the dirt and albumen will be thrown to the bottom of the kettles, and there burn, as it cannot be taken out. All sandy soils are the reverse, the juice contains acid; all new lands yield an excess of albumen and acid.

"Acids neutralize alkalies if in ascendancy, but should alkalies be in the ascendancy, they will neutralize the acids. Bi-sulphite of lime acts powerfully as an acid in coagulating the albumen and neutralizing the alkalies, and also in bleaching the juice; but, when neutralized with lime the bleaching disappears. The use of lime is indispensable though only as a neutralizer of acids.

"The quantity of bi-sulphite to be used will depend entirely on the quantity of the impurities in the juice, for if the juice be alkaline, the bi-sulphite will be measurably neutralized, and of course will be required in greater quantity to neutralize the alkali, which must be done to obtain a speedy clarification. What we call a perfect clarification is, when the juice poured from the ladle is transparent, when the bubbles are as brilliant as clear glass.

"When this is obtained, the *Sero* and *Baterie* will be free from dirt or gum. Some juice will not require more than two gallons of bi-sulphite to a hogshead of sugar; while others will require three times that amount. The most successful way to use bi-sulphite of lime is to measure it, and put it in the vat as soon as the juice commences running from the mill, that it may get well mixed; always use the strongest, say that which weighs from nine to ten degrees. The quantity to be used in the juice of cane that is taken from wood or sandy land, is about one and a half quarts to a 72-inch *Grande*. Stiff prairie land cane will require double that quantity, and in rare cases treble.

"Use no lime until the juice has boiled and been skimmed in the *Grande*. As soon as you commence passing from the *Grande* to the *Flambeau*, then put dry lime in the *Flambeau*, sufficient to neutralize the bi-sulphite, which can be known by trying it with litmus paper, (acids redden litmus paper, but in alkalies it remains blue). After the juice has been cleaned in the *Flambeau*, then test the amount of acid, and neutralize to a purple colour, which will give a perfect clarification; if not, use more bi-sulphite in the vat. Lime in the *Flambeau* produces an effervescence while neutralizing the acid which throws all the impurities to the surface at once, which makes it appear very dirty; but in a few minutes the juice will be transparent and no dirt beyond the *Flambeau*.

"The quantity of lime to one-half gallon bi-sulphite will vary from 18 to 36 cubic inches in stiff prairie land cane. In wood land from 48 to 76 inches; extreme cases may vary slightly.

"Two inches is about the proper depth for each strike in the cooler; stir twice, when first off, and when the crust is forming.

"Let your sugar remain in the cooler until it gets quite cool before being potted, as the grain is not firm while there is any warmth in the cooler.

"Draining cane in the hogshead is unnecessary."

RESEARCHES ON BOILING IN VACUUM.

BY DR. B. WACKERODER.

(Continued from page 630, vol. iii.)

D.—EFFECT OF PURE WATER.

1,—PURE SYRUP (FROM SUGAR IN CRYSTALS).

5th boiling.—(*a*) 8 litres of syrup boiled to grain.
,, ,, (*b*) 8 litres of syrup boiled dry, with water constantly added to 3·75 litres.

Composition of the above—

	V. (*a*)	V. (*b*)
Water	14·78	14·24
Foreign matters	0·42	1·66
Sugar	84·80	84·10
	100·00	100·00

In 100 parts of dry substance—

	V. (*a*)	V. (*b*)
Water	—	—
Foreign matters	0·49	1·93
Sugar	99·57	98·07
	100·00	100·00

Syrup from 4th Product of Refining.

25th boiling.—10 litres of syrup boiled dry, finished at 65° Cent.; this boiling was re-dissolved with hot water, then re-concentrated (boiling 26), this again re-dissolved and re-concentrated through successive boilings 27, 28, 29, and 30. The volume of the last boiling was sensibly diminished by proving, and admitted of the successive addition of 13 litres of water. When concentrated it was yellow and viscous.

Composition of *masses cuites*—

	XXV.	XXVI.	XXVII.	XXVIII.	XXIX.	XXX.
	First boiling.	Obtained by the re-solution of the *masse* of each preceding boiling.				13 litres of water added.
Water	13·49	14·83	11·53	12·38	13·30	12·10
Salts	1·67	1·65	1·85	1·66	1·75	2·69
Organic substance	0·94	0·92	1·62	2·26	2·25	1·71
Sugar	83·90	82·60	85·00	83·70	82·70	83·50
	100·00	100·00	100·00	100·00	100·00	100·00

In 100 parts of dry substance—

	XXV.	XXVI.	XXVII.	XXVIII.	XXIX.	XXX.
Water	—	—	—	—	—	—
Salts	1·93	1·94	2·09	1·89	2·02	3·06
Organic matter	1·07	1·08	1·83	2·58	2·59	1·94
Sugar	97·00	96·98	96·08	95·53	95·39	95·00
	100·00	100·00	100·00	100·00	100·00	100·00

4.—Sweet Waters.

32nd boiling.—5 litres of sweet water concentrated at 63° to 71° Cent., 5 litres added, and concentration completed at 71° Cent. (162° Faht.)

33rd ,, (*a*) 5 litres concentrated at 61° Cent. (142° Faht.), 1 litre of water added at 60° Cent. (140° Faht.)

33rd ,, (*b*) 5 litres with the addition of 4 litres of water concentrated at 80° Cent. (176° Faht.)

Composition of sweet waters concentrated—

	XXXII.	XXXIII(*a*).	XXXIII(*b*).
Water	96·15	97·44	95·74
Foreign matters	0·10	0·06	0·18
Sugar	3·75	2·50	4·08
	100·00	100·00	100·00
In 100 parts of dry substance—			
Water	—	—	—
Foreign matters	2·60	2·35	4·22
Sugar	97·40	97·65	95·78
	100·00	100·00	100·00

These details show as clearly as can be desired that at a high temperature water exercises a hurtful influence on sugar, and that it is essentially a *mélasigéne* substance. This fact constitutes a serious argument against the use of sulphurous acid in aqueous solution.

No. 2.

RESULTS OF BOILING IN VACUUM.

1.—Diminution and Increase of Polarimetrical Effect during the Boiling.

If we compare the composition of solutions and syrups before and after boiling, in general an increase of polarimetrical effect is observed. The respective figures before and after are not given in the above tables in order that the results obtained by the action of different agents should not be confused; the following table will furnish the necessary comparisons; the boilings with those reagents which diminish polarization are not given, in order that the effect of boiling pure and simple may be shown.

Number of Boiling.	KIND OF SYRUP.	Composition of dry substance						Increased or diminished Polarization.	Temperature at the end of boiling.	Proportion of Water	
		from Syrup.			from *Masses Cuites.*					in the *Masse Cuite*	in the Syrup.
		Salts.	Foreign Matter.	Sugar.	Sugar.	For'gn matter	Salts.				
III.	Concentrated juice	3·76	4·53	91·71	92·49	3·64	3·87	+ 0·78	84° C. (180° F.)	15·77	47·01
V(*b*).	Clearing syrup	0·11	0·79	99·10	99·51	0·32	0·17	+ 0·41	.. ..	..	..
VI.	Concentrated juice	4·31	4·50	91·19	91·97	4·07	3·96	+ 0·78	.. ..	15·08	46·99
XII.	Green syrup (1st product)	8·84	11·04	80·12	81·83	9·51	8·66	+ 1·71	.. ..	15·07	23·61
XVII.	Clearing syrup	0·39	0·95	98·66	98·81	0·84	0·35	+ 0·15	65° C. (149° F.)	35·94	43·24
XVIII.					99·23	0·47	0·30	+ 0·57	69° C. (156° F.)	21·00	
XIX.					97·17	2·55	0·28	— 1·43	63° C. (146° F.)	16·44	
XX.					97·76	1·97	0·27	— 0·90	66° C. (151° F.)	15·81	
XXI.					97·52	2·21	0·27	— 1·14	75° C. (167° F.)	13·97	
XXII.	Syrup (4th product)	1·79	2·57	95·64	95·31	2·28	1·81	— 0·33	73° C. (164° F.)	13·76	45·94
XXV.					97·00	1·07	1·93	+ 1·36	65° C. (149° F.)	13·49	
XXXI.	Sweet water	0·00	0·00	100·00	97·40	2·60		— 2·60	65° C. (149° F.)	96·15	98·14
XXXV.	Covering syrup	0·17	0·15	99·68	99·51	0·32	0·17	— 0·17	65° C. (149° F.)	14·78	30·18
XXXVIII.					98·63	1·20	0·17	— 1·05	58° C. (136° F.)	15·49	
XXXIX.					98·40	1·43	0·17	— 1·28	62° C. (144° F.)	12·91	
XL.	Green syrup refined	3·96	4·29	91·75	92·35	3·74	3·96	0·55	69° C. (156° F.)	16·47	30·03

The increase of polarization in the first place may be effected by a real increase in the proportion of sugar, on the supposition that certain organic combinations are volatilized during the boiling, which is very nearly certain. If that is true, the necessary consequence will be that the boiling of saccharine matters very nearly pure will not cause any increase, but rather a diminution of polarization in consequence of the decomposition of sugar by boiling with water alone.

The following are the results of some experiments made with a view of proving this,—with some very pure covering syrup.

35th boiling.—5 + 3 litres boiled to grain at 70° C. (158° F.)
38th ,, 5 + 1 ,, ,, 58° C. (136° F.)
39th ,, 5 + 1 + 1 ,, 62° C. (144° F.)

Composition of *masses cuite*—

	Syrup.	XXXV.	XXXVIII.	XXXIX.
		Boiled.		
Water	30·18	14·78	15·44	12·91
Salts..........	0·12	0·42	1·16	1·39
Organic matter..	0·10			
Sugar	69·60	84·80	83·40	85·70
	100·00	100·00	100·00	100·00

In 100 parts of dry substance—

	Syrup.	XXXV.	XXXVIII.	XXXIX.
Water	—	—	—	—
Salts..........	0·17	0·17	0·17	0·17
Organic matter..	0·15	0·32	1·20	1·43
Sugar	99·68	99·51	98·63	98·40
	100·00	100·00	100·00	100·00

It appears that the increase of polarization is produced in certain less pure solutions by the water itself, which gives place to the formation of new substances acting powerfully on polarized light like dextrine. It is clear that in this case the polariscope does not constitute a sure means of finding the proportion of pure sugar in a *masse cuite.* Evidently the formation of new substances may coincide with the elimination of others.

Let us sum up our results:—

(*a*) The pure *masses cuites* generally polarize less than the syrups before boiling, which may be the result of decomposition during boiling.

(*b*) The *masses cuites* from less pure syrups generally polarize higher than the syrups from which they are produced. The more foreign organic substances the syrups contain the more evident does the increased polarization of the *masses cuites* become.

(*c*) The use of sulphurous acid gaseous or in solution caused a loss of polarization as high as 1·5 per cent. It would appear that the sulphurous acid fixes some of the substances which would otherwise be eliminated by boiling.

(*d*) Many more researches will have to be made before anything positive is proved on the nature of the changes taking place during boiling.

B.—CHANGE OF COLOUR IN THE MASSES AFTER BOILING.

It appears that all *masses cuites* become darker in colour after a certain time. Thus *masses* effectively bleached by sulphurous acid will take a much darker colour after some days. Below are some instances of this.

	XXII. Without sulphurous acid.	XXIII. With sulphurous acid.	XXIV. With gaseous sulphurous acid.	
Showed on 4th of April	220	170	110	deg. colorimeter
,, ,, 25th ,, ,,	320	230	170	,, ,,
Increase in 21 days ..	100	60	60	,, ,,
Increase of colour ..	43°/o	35°/o	55o/°	

	XL.	XLI.	XLII.	
Showed on 15th of April	4200	2800	700	deg. colorimeter
,, ,, 25th ,, ,,	6500	4000	2600	,, ,,
Increase in 10 days ..	2300	1200	1900	,, ,,
Increase of colour ..	54°/o	43°/o	271°/o	

ON THE MANUFACTURE OF SUGAR FROM THE SUGAR CANE, AND THE MACHINERY EMPLOYED THEREIN.

(*Continued from page* 623.)

Having described in our last paper the system of sugar-making in most general use, we will now proceed to speak of improved methods of manufacture. In so doing it will be most convenient to begin with a description of the more simple methods, and go on from these to the more complicated apparatus which becomes necessary when the planter desires to turn out fine sugar fit to pass directly into the hands of the consumer.

Taking the various systems of manufacture in this order, our attention will first be directed to Fryer's "Patent Concretor," the invention of Mr. Alfred Fryer, of Manchester.

This apparatus, although only of recent invention, has, we are informed, already been introduced into most of the tropical sugar-producing countries of the world, and in some of them it is rapidly coming into general use. The concretor was invented for the purpose of concentrating the clarified juice in the shortest possible time with the least expenditure of manual labour, and so far as possible without change in its colour or chemical composition, into a solid mass suitable for the refiner to operate upon, but not intended to pass at once to the consumer.

Its inventor believes, rightly or wrongly, that the delicate operations of refining can be carried on more cheaply in Europe than in the tropics. He bases this belief on the following facts:—

1st. The cost of machinery is very much less here than there.

2nd. We have skilled labour in abundance and at a reasonable rate, while in the tropics it is difficult to obtain and very costly.

3rd. Fuel is abundant and cheap in Europe, while so soon as the planter has exhausted his megass or crushed cane, he must either use very inferior fuel or pay a very high price for good.

4th. But few planters can afford the outlay required for thoroughly refining the sugar they make.

5th. Even if the planter have the requisite machinery for

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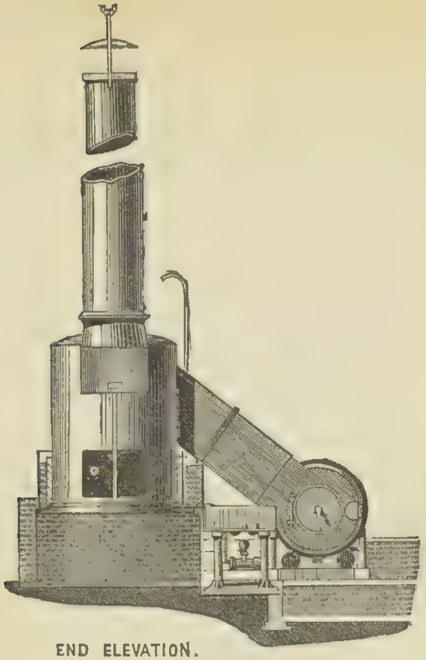
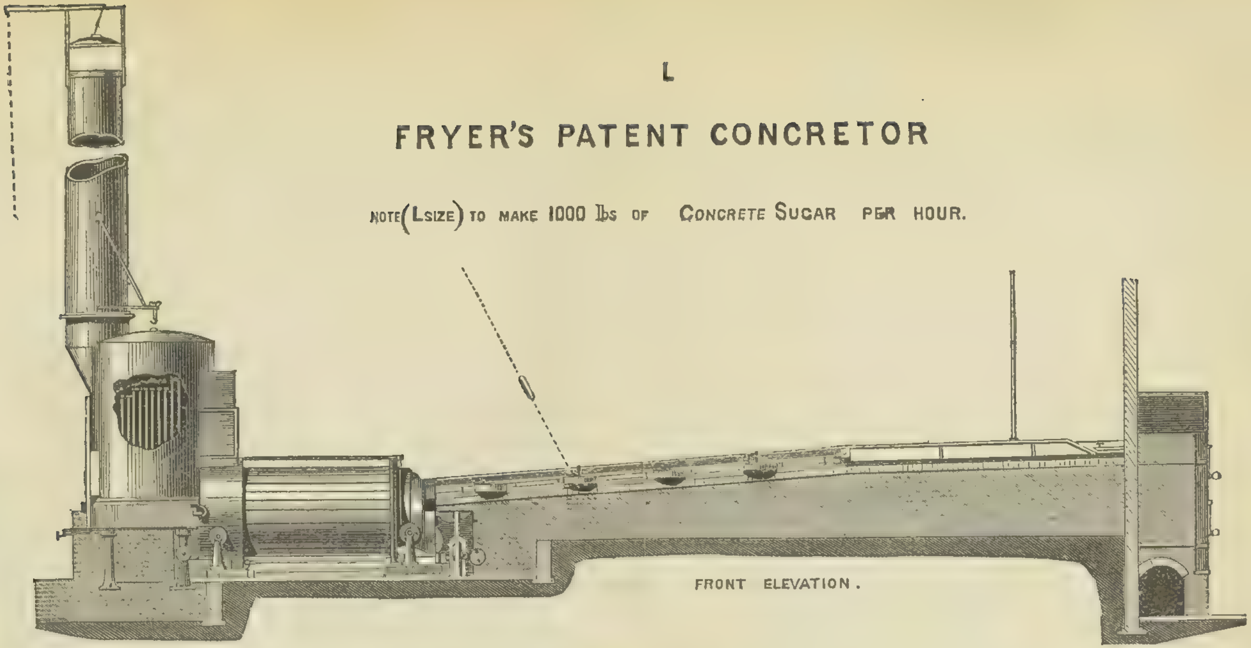
FRYER'S PATENT CONCRETOR

NOTE (L SIZE) TO MAKE 1000 lbs OF CONCRETE SUGAR PER HOUR.

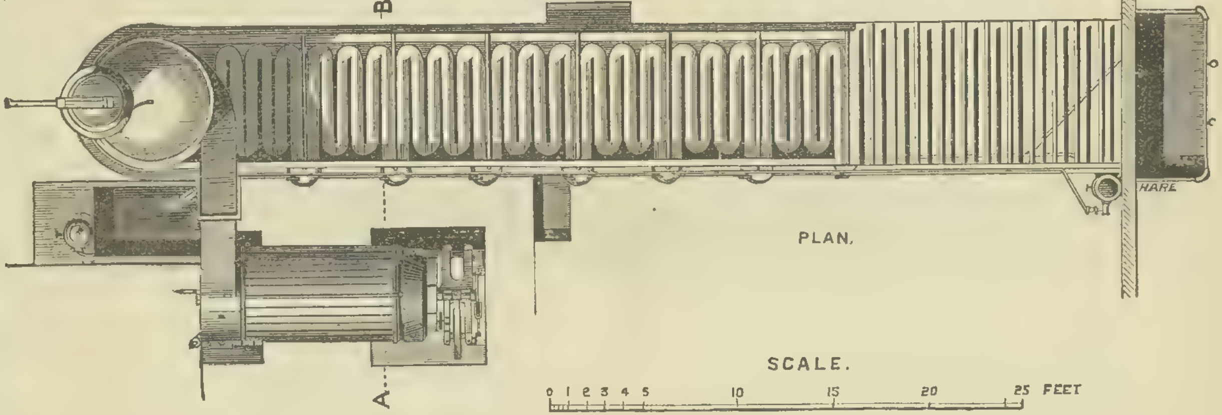


END ELEVATION.

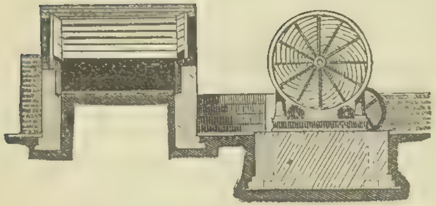


FRONT ELEVATION.

MANLOVE ALLIOTT & Co MAKERS NOTTINGHAM & ROUEN.



PLAN.



SECTION ON LINE .A.B

SCALE.

0 1 2 3 4 5 10 15 20 25 FEET

refining he usually works it by day only, and for not more than three to four months out of the year, while the European refiner works often both night and day, and the whole year through, thus employing far less capital than the planter would need to do the same work.

These arguments appear to us very weighty, though of course there is something to be said on the other side of the question, as for instance, that the planter can usually obtain unskilled labour at a very low rate, and that he is obliged to manufacture his sugar in some way.

Let us, however, now turn to the machine itself, and examine its construction and working.

Fig. 1 is a side elevation; fig. 2 a plan; fig. 3 an end elevation, and fig. 4 a cross section of it.

It consists of a series of shallow trays, A A A, placed end to end, and divided transversely by ribs running almost from side to side.

At one end of these trays is a furnace, B, the flue of which runs beneath them, and at the other end is an air-heater, C, which makes use of the waste heat from the flue, and employs it in heating air to be made use of in the revolving cylinder, E.

Between the trays, A A, and the revolving cylinder, E, is a small tank, D.

The whole series of trays, A A A, is placed on a slight incline, the upper end being next the furnace. The upper three trays are made of wrought iron, since the intense heat here would render cast iron liable to fracture.

The clarified juice from the tank, F, flows first on to the top tray, *i.e.*, the one next the furnace; it cannot flow straight down the incline towards the air-heater, C, because of the transverse ribs already alluded to, which baffle it, and oblige it to flow from side to side of the tray in a shallow stream, in the direction shown by the arrows.

Thus it has to traverse a channel some 400 feet long before it can flow away from the trays at the end next the air-heater, although the distance from the furnace to the air-heater, in a direct line, is not quite fifty feet.

While flowing over these trays the juice is kept rapidly boiling by means of the heat from the furnace, and although it only takes some eight to ten minutes to traverse them, its density is, during this short time, raised from say 10° to about 30° Baumé.

From the trays the thickened syrup flows into the tank, D, and thence passes into the revolving cylinder, E. This cylinder is full of scroll-shaped plates of iron, over both sides of which the thickened syrup flows as the cylinder revolves, and thus exposes a very large surface to the action of hot air, which is drawn through it by means of a fan, G; motion is given to the whole apparatus by means of a small engine, H. In this cylinder the syrup remains for about twenty minutes, and at the end of that time flows from it at a temperature of about 195° to 200° Fahrenheit, and of such a consistency that it sets quite hard on cooling. Thus properly made "concrete sugar" forms a solid mass, not liable to drainage during transport, and ready for immediate shipment.

It therefore appears that by means of the concretor the whole process of concentration may be accomplished in half an hour. While on the "tray" portion of the apparatus, the temperature of the juice varies from about 212° to about 216° Fahrenheit, rarely attaining the latter figure, and to this temperature it is exposed for only a very few minutes. The greatest heat of the furnace is applied to the thinnest liquor, which is best able to carry off great heat because of the low temperature at which it boils, and its great fluidity, while, as the syrup becomes more and more dense, the heat applied to it becomes less and less intense.

On first entering the cylinder the temperature of the syrup at once falls to about 160° Fahrenheit, on account of the rapid evaporation from its surface as the hot air passes over it. This temperature gradually rises to about 200° Fahrenheit at the point where it is discharged. If discharged at a much lower temperature than this, the material would not set hard on cooling.

From the time when the clarified juice first flows on to the top tray of the apparatus, until the time when it issues from the cylinder in the shape of concrete sugar, it requires no handling at all, since the juice gravitates from one part of the apparatus to another, attendants having only to see that the proper quantity of juice is supplied to the apparatus, and that the material as it issues from the cylinder is of proper consistency.

Since the whole of the concrete sugar issuing from the apparatus sets into a solid mass on cooling, it will be seen that when the concretor is used no molasses are made. In fact the machine concentrates the whole of the solid matter contained in the clarified juice into a portable form, and then hands it over to the refiner for him to conduct all further operations in reference to it.

It will be seen from the above description that the concretor fulfils both the main requirements laid down in our last paper as requisite in an apparatus for concentrating solutions of sugar. 1st. In no part of the apparatus is the temperature excessive, and where the syrup is most dense, and therefore most liable to injury, the temperature is especially moderate. 2nd. The time during which the sugar is exposed to heat is very short. As there pointed out, this short process of concentration does not give time for the formation of crystals, but these are not needed in concrete which is intended only for the refiner.

When the concretor is used for making centrifugaled sugars, as we shall have occasion hereafter to point out that it may be, the size of the crystals may be increased by allowing a certain portion of the material from the discharge end of the cylinder to pass back again to the supply end, thus passing it through the cylinder again along with the thinner juice, also entering it. The minute crystals already formed in the thickened material grow in size by the addition of saccharine matter from the thinner syrup, in which no crystals have yet begun to form, and by this means the size of the crystals may be very considerably increased.

We have pointed out that the principles on which the concretor is constructed are theoretically sound. We are able to state from personal observation that the machine is, in practice, capable of concentrating cane juice or solutions of sugar without perceptible injury to them. We have seen a piece of freshly made concrete dissolved in water, and water added until the solution of dissolved concrete was of the same density as the liquor flowing on to the concretor, and on comparing the two we have not been able to detect the slightest difference in colour between them. At the same time we believe that to obtain such a result as this, the machine must be worked with care.

The quality of the concrete sugar produced by the apparatus will, of course, vary greatly according to the quality of the juice supplied to it. Since no molasses are produced, the whole difference in the quality of juice must of necessity be represented in the concrete. When crystallized sugar is made, this is not the case, since when working up inferior juice much more molasses is produced, and thus the sugar actually obtained is not so much degraded in quality as reduced in quantity.

Whether it be to the advantage of the sugar planter to work for the refiner, as the cotton planter works for the cotton spinner, or to compete with him, each planter must decide for himself. The decision will doubtless vary according to the outlet which the planter happens to have for fine sugar, the capital at his command, and the proportion of the year during which he can keep his machinery at work.

If, however, he should decide to work for the refiner, as the very great majority of planters at present do, there can be little doubt that it is his interest to manufacture his juice as little as possible, but to hand it over to the refiner as nearly as may be in its original form.

Now, the planter endeavours roughly to make crystallized sugar, and to separate it from the molasses. The result usually is, that he injures his sugar very greatly, both in colour and chemical composition, and that he turns out a sugar from which the refiner extracts a quantity of molasses, and molasses from which the refiner extracts a quantity of sugar.

The concretor only performs those processes which are absolutely necessary, and when properly worked enables the planter to hand over the concentrated juice in an uninjured form to the refiner.

That concrete sugar is appreciated by the refiner is proved by various documents now before us, and by the fact that those refiners who have used it most largely are those who bid for it most keenly.

ON THE PURIFCATION OF SUGAR SOLUTIONS FOR THE OPTICAL SACCHAROMETER.

BY P. CASAMAJOR.

In the April number of this year's *American Chemist*, page 378, is an article by Dr. Stammer, taken from the *Sugar Cane*, on the use of animal charcoal in purifying saccharine solutions for polarimetric analysis. The conclusion which is drawn from the experiments detailed in the article is that animal charcoal absorbs sugar from its solutions, and cannot therefore be used for clarifying saccharine solutions for analysis. This conclusion is certainly interesting in a scientific point of view, but hardly less so in its practical bearings to the sugar manufacturer and refiner. It is a matter of such importance that it cannot be accepted without incontrovertible proof, even if supported by such authority as the name of Dr. Stammer.

After making a great many experiments, I am in a position to state that *animal charcoal does not absorb sugar from its solutions* in the same manner as it absorbs colouring matter, salts of lime, magnesia, iron, etc.

The proof of this I have obtained by eliminating with care every source of error and repeating the experiments several times with different sugars.

I have proceeded as follows: In the first place, a solution was used of a sugar light enough to give a liquid fit for the saccharometer with acetate of lead, but without using animal charcoal. This solution was placed in the saccharometer, and the result obtained noted.

This same solution was afterwards filtered over animal charcoal containing 3·8 per cent. of water. The saccharometer indicated 2 per cent. less of sugar.

Another portion was filtered over animal charcoal containing 8·8 per cent. of water. The saccharometer indicated a loss of 5 per cent.

For instance: 16·35 grms. of a light-coloured sugar was dissolved so as to occupy 100 c. c. The solution after treatment with sub-acetate of lead was of a light yellow colour. The saccharometer indicated 90 per cent. With the portion filtered over animal charcoal containing 3·8 per cent. of water the saccharometer indicated 88 per cent. With the portion filtered over animal charcoal containing 8·8 of water, the saccharometer indicated 85 per cent. These results show that the presence of water in the bone black will affect the strength of the solution.

The next step was to filter the saccharine solution over perfectly dry animal charcoal. This was obtained by heating animal charcoal for over two hours over a lamp, at 350° F. and *throwing the black, while hot, into a hot and dry bottle.* Immediately afterwards the bottle was hermetically closed.

When this dry black is used, no loss of sugar is shown by the saccharometer. There cannot be an error in this as the experiment was repeated several times with the same uniform result.

It has been stated that the conclusion of Dr. Stammer is, that animal charcoal absorbs sugar from its solutions. If, however, we examine attentively the table from which this conclusion is drawn, we will notice that the differences between the per centages of sugar before and after filtration are very small, varying from 0·2 of 1 per cent. to 0·6 of 1 per cent., except in cases where bone black was used in large quantities, twice or three times as much as in the greater number of cases. The time of contact of the bone black with the saccharine solution does not seem to have had any influence on the pretended absorbing power of animal charcoal for sugar. These times of contact vary from 3 hours to 24 hours, but the pretended quantities of sugar absorbed vary independently of these times. The variations when they occur are less than ½ per cent. Nobody who has experience in tests by the Optical Saccharometer needs to be told that such variations must necessarily take place even on testing the same solution twice in succession, particularly if it is not perfectly colourless.

In examining the two tables, it seems strange that there is so little difference in the comparative results, as the experiments of

Table 1 were made with animal black that had been heated at 230° F., and those of Table 2 with animal black that had been heated at 350° F. Bone black heated at 230° F., does not lose all its water. The water remaining in the black, heated at 230° F., will certainly affect the strength of the solution and produce an apparent absorption; while bone black heated long enough at 350° F., loses all its water, and will not affect the strength of the solution. That the portions mentioned as absorbed are very nearly alike in both tables, except when larger quantities of bone black are used, shows that the bone black was not kept perfectly dry.

It is of the utmost importance to use bone black that has been *kept dry in a closed bottle.* If the bone black is allowed to cool in the open air it very quickly absorbs moisture. If used hot it increases the temperature of the solution, and by expansion decreases the per centage shown by the saccharometer. As to putting it in the solution hot and allowing it to cool, if left for several hours, as in some of the tests in these tables, there is great danger of losing sugar by fermentation.

Instead of bone black I use a process, to obtain colourless saccharine solutions, which has answered with all grades of sugar, and which certainly does not take any additional time, or give any additional trouble. This process is founded on the observation that the facility and perfection of clarifying a solution of sugar by sub-acetate of lead seems to depend on the quantity of mineral salts contained in the sugar. Thus many very dark inferior sugars, such as Manillas, will give solutions which are easily clarified by sub-acetate of lead, producing at the same time a dense precipitate. Such sugars give on incineration a large quantity of ashes. Other saccharine products, particularly those that have been filtered over bone black are not very dark, but sub-acetate of lead acts on them imperfectly, giving a light precipitate which stops up the pores of the filters.

Acting on the above observation, I add to saccharine solutions soluble salts capable of giving dense precipitates, with sub-acetate of lead. I have used at different times chloride of sodium, sulphate of soda, phosphate of soda, and acid phosphate of lime, and have found them all equally effective. Other chlorides, sulphates, phosphates, iodides, etc., will doubtless give the same result.

The soluble salt is added by throwing a pinch of it on the sugar, and dissolving by water afterwards, or by putting in a few drops of a solution of the salt.

The results obtained are very satisfactory, as the solutions are quite, or nearly, colourless, whatever be the kind of sugar treated. A secondary advantage is that the precipitate is very dense and easy to filter, while some of the sugars without the addition of the salts, filter very slowly.

By a succession of experiments I have ascertained that the addition of the salts mentioned above does not affect the saccharometric per centage of the solution.

In connection with the subject of purifying sugar solutions for the saccharometer, there is an important fact, discovered in this laboratory, by Mr. Henry O. Havemeyer. When in saccharometic tests we are obliged to invert, as in tests of molasses, melados and very low sugars, the hydrochloric acid used produces such a red colour that the solutions are not fit for the saccharometer unless we are careful not to heat them above 68° C., and to cool them as soon as possible afterwards. The inversion is often imperfect under these circumstances, and the safest way is to invert again until no change is shown by the saccharometer. If this is repeated the red colour will appear even if the solution is not heated above 68° C., and is cooled quickly.

The important fact mentioned above is, that the addition of a small quantity of proto-chloride of tin will prevent the formation of the red colour even if the solution is heated above 70° C., several times, until no variation is shown by the saccharometer.—*American Chemist.*

DETERMINATION OF MOISTURE IN BONE BLACK.

By Dr. I. Walz.

A dispute having recently arisen as to the proper temperature at which the moisture in bone black should be determined, and a reference to the books showing that authorities differ on this point, I made a series of experiments of which I propose to give the results:

	Time.	Temp. Faht.	Loss H_2O.
1. A sample of bone black	1 h.	250°	6·85 p. c.
2. Same sample	1 h.	350°	6·73 ,,
3. Same sample	longer	,,	6·66 ,,
1. A sample of bone black	1 h.	212°	5·68 ,,
2. Same sample	1 h.	250°	5·83 ,,

The following was made as a crucial test: a sample of bone black was heated for six hours at 350° Faht., then weighed and placed under a bell jar which dipped into water. After 18 hours it had absorbed 15·24 per cent. of water. This sample, heated 1½ hours at 212° Faht., lost 14·23 per cent. of water; heated one hour at 250° Faht., the whole of the moisture was expelled.

Another sample of bone black, heated one hour at 250° Faht., lost 6·17 per cent. of moisture; another portion of the sample was left 24 hours in the desiccator over sulphuric acid and showed a loss of 6·18 per cent.

These experiments lead to the following conclusions:—

1. The moisture contained in bone black may be estimated by heating the latter one hour at a temperature of 250° Faht., or by leaving it 24 hours in the desiccator over sulphuric acid.

2. If bone black is exposed to a much higher temperature than 250° Faht. for a sufficient length of time, an increase of weight (probably caused by oxidation) takes place, and the amount of moisture will be found too low.—*American Chemist.*

THE SUGAR MANUFACTURE IN JAVA.

From the French.

(Annales du Commerce Exterieur.)

Amongst all the colonies the island of Java is certainly for many reasons one of those in which the sugar cane will be best able to compete the longest and most successfully with the vigour of the sugar beet.

1. The island of Java is out of the course of those cyclones or terrible hurricanes which periodically devastate other sugar colonies and damage or destroy their crops.

2. All the cane plantations are generally irrigable to some extent. In case of drought they are assured against the want of this element, indispensable to all tropical cultures—the water of irrigation. For this reason their growth is much more rapid than in other colonies, where the means of irrigation is more or less wanting. On the other hand, the heat is more constant in Java, being only 5° 30′ south of the Equator, instead of 18° to 20° distant like some other colonies. Then this great heat, combined with frequent rains which moderate it (or with irrigation which replaces them when needful), produces extraordinary vegetation.

3. The labour of the aborigines is amply sufficient, and its expense is moderate; whilst in other colonies the imported labour is dear, and often scarce at important times.

4. Java has another advantage in the neighbourhood of a great market, where the greater part of its sugars could be disposed of. This market is Australia. There are two causes which up to this time prevent its profiting by this advantage. The first is the Government monopoly, which obliges two-thirds of the produce of all the central factories in the island to be shipped to Holland; the second is inherent in the quality of the sugar itself, which has a very bad smell in consequence of the method used in bleaching it, and which is known by the name of *terrage*.

There are in Java 153 sugar factories, of which 140 large ones produce together an average quantity annually of 1,900,000 piculs

(116,000 tons) of sugar. Of these 140 factories, 96 are called *central*, because they are generally placed in the centre of twenty or thirty villages, the native population of which are obliged to cultivate the 400 hectares (988 acres) allowed by Government for twenty years to every manufacturer who obtains a farm contract.

These factories are situated as under:—

In the District of Cheribon there are 10; in that of Zegal, 9; in that of Pecalongan, 3; in that of Samarang, 11; in that of Japara, 2; in that of Rembang, 1; in that of Sourabaya, 20; in the Residence of Madura, 1; in that of Passaronan, 17; in Probolinget, 10; in that of Besanki, 5; in Banjonnas, 1; in Madionan, 2; in that of Kediri, 4;—total, 96.

At present it is estimated that two-thirds of the central factories use water power to crush the canes and one-third use steam.

In all the central factories, except five or six which follow the old battery system, the graining is effected by means of vacuum pans.

The cane juice is concentrated up to 27° or 28° Baumé over the open fire, arrived at which point it is then transferred to the vacuum pan to be finished in the ordinary way, and better still to be crystallized according to the *Montclar* method—that is to say, concentrated to total dryness—the whole mass then emptied from the pan by means of an opening 33 centimetres (11·8 inches) in diameter. From the pans the sugars go into receivers where before being centrifugaled, they are subjected to the bleaching process used in Java—that is to say, the washing by water called *terrage*, by which the sugar acquires an unpleasant smell.

The average profit of the manufacturer is proportioned to the yield of his crops. In the 96 central factories there are great differences in returns, according to the fertility of the soil and the varieties of the cane.

There are four factories in which 80 *piculs* of sugar per *bouw* (39 cwts. per acre) are obtained, in each of these the profit is nearly £8,250 per annum.

Four others obtain 70 *piculs* per *bouw* (34 cwts. per acre), their profit is £5,775 per annum each.

Ten reach the figure of 60 *piculs* per *bouw* (29 cwts. per acre), their annual gain is £4,125 each.

Ten more obtain 55 *piculs* per *bouw* (nearly 27 cwts. per acre), the annual gain of each is £3,300.

Ten obtain 50 *piculs* (above 24 cwts. per acre), the profit of which is £2,475 each.

Ten others obtain 45 *piculs* (nearly 22 cwts. per acre), their average profit is about £1,000.

Of ten the yield is 40 *piculs* (not quite 1 ton per acre), the profit of each is only about £300 to £400.

There are nearly 30 other factories which only obtain from 35 to 37 *piculs* per *bouw* (17 to 19 cwts. per acre), these are subject to annual losses of from £1,000 to £2,000 each.

The most certain profit is that pertaining to the Government, which draws a large sum yearly from each factory, representing a total revenue of more than 8 millions of francs (£320,000).

THE PRODUCTION OF SUGAR IN ITALY.

By Robert Burger, Madgebourg.

(From the French.)

Italy has only very recently been reckoned amongst the beet sugar producing countries. In the year 1868 a proprietor in the Papal States made some experiments on a large scale in the culture of beet—experiments which were very successful.

The beets were sown in the different experimental fields towards the middle of the month of February. The shoots were very vigorous, and the growth so rapid that towards the end of June the average weight of the beets was 1 kilog. 200 gram. ($2\frac{3}{4}$ lbs.).

From the 27th July to the 20th of August many samples of the beets grown on the different plots of land were successively analysed in the most celebrated laboratories of Paris. These analysis gave very favourable results, especially the *Vilmorin* obtained from two varieties of these beet roots grown in the neighbourhood of Magdeburgh. In fact, one chemist found 13·30 and 14·47 per cent. of sugar in 100 parts of juice; another obtained 12·61 and 13·44 per cent.; whilst the beet roots analysed in Rome showed in the polariscope 10 to 12 and from 12 to 14·5 per cent.

Other beets raised from common seed only contained 9 per cent. of sugar at the same period of growth.

The great saccharine richness of the *Vilmorin* beet root, which in Italy co-exists with very good returns in weight, allows of the advantageous cultivation of this variety. According to the last accounts the beetroots can be delivered at the factories at 20 francs the 1000 kilogs., about 16s. per ton; coal costs 45 fr., and wood 12 fr.; labour costs about the same as in the sugar districts of France—nothing appears to be unfavourable.

Based on these generally propitious circumstances, which guarantee the vitality of the sugar industry in Italy, the proprietor named above did not hesitate to demand a concession for the construction of a sugar factory.

The Papal Government accorded him an exclusive privilege, by fixing, for a term of 18 years, the impost of 4 fr. 5 c. per 100 kilogs. of sugar produced (1/8 per cwt.), instead of the usual duty. Thus, whilst sugar imported into Italy is liable to a duty of 21 fr. 10 c. per 100 kilogs. (8/6 per cwt.), indigenous sugar will only pay the small impost above mentioned.

The factory built near Rome in 1869 having obtained this privilege, has already been at work during two seasons. According to information received from the same source, the Italian Government having annexed the Papal States, will confirm to the *concessionaire* the same privileges, but only as regards the former States of the Church.

Since then, other experiments have been made in other districts of Italy, especially in the environs of Turin and in the province of Abruzzes.

We have ourselves several times sent beet root seed into Italy.

The Italian Government has taken a lively interest in the introduction of this industry into the country. In fact last year a former "Minister of Public Works" visited the chief centres of the sugar manufacture in Germany, France, Belgium, and Austria, with the aim of collecting the necessary material for the culture of the beet and the manufacture of sugar and to study thoroughly all the questions relating to this industry.

Founded on the theoretical information thus collected several small practical applications have been commenced, and as other persons are equally interested in the sugar manufacture, we cannot expect that the factory near Rome will long remain the only one in Italy.

Thus we have learnt that a Society has been recently formed in Turin with the object of introducing the sugar manufacture and that it will shortly erect a factory at Savigliano. Another is to be established at Cesa, in Tuscany. The beets cultivated in this locality in 1870 gave a return of 8¾ per cent. of sugar. Another sugar factory is being erected at Riéti.

At the same time we hear from Vienna that a Society there has concluded an arrangement with the Italian Government by which the manufacture of sugar in Italy is monopolised, that the Italian Government has promised a privilege of 25 years according all rights of duty and other advantages, and even the partial prohibition of the importation of sugar into the country.

We are not able to say how far this latter news is true, and whether as appears this Viennese Society is the same as the one which has been formed in Turin.

Magdeburgh, 5th Dec., 1871.

P.S.—Two anonymous Societies have been established for the manufacture of sugar in Rome, the one with a capital of ten millions of francs, the other of five millions.

CANE CULTURE IN QUEENSLAND.

We are indebted to the *Queensland Courier* for the following extracts:—

"As the success of sugar, tobacco, and other tropical and semi-tropical products becomes more decided, the occupation of land for the cultivation of these crops increases. * * Already this is going on north and south with much greater rapidity than has ever been witnessed before. The Herbert Valley is attracting attention just now as a sugar-producing district. Another and still more effective drain on the labour supply will be the settlement of labourers on land of their own, as independent cultivators of the soil. The experience of the past two or three years, and notably of the last twelve months, has proved that the skilful, prudent, industrious cultivator of a few acres of sugar-cane in the neighbourhood of a mill stands as fair, and in the majority of cases a fairer chance of success even than the large proprietor. The time spent by the labourer in working for wages on other people's land, proves to be the best possible training for successfully engaging in the same pursuit on land of his own; and as the market for his produce is practically unlimited, there is no danger of a glut. Nothing in the history of the colony is more surprising than the rapid strides made in the cultivation of the sugar-cane within the last two or three years."

CUSTOMS REVENUE.—The revenue for the port of Greenock fo the month ending 30th November, as compared with the corresponding month in the two previous years, was as follows:—November 1869, £141,717 14s. 6d.; November 1870, £85,398 11s. 4d.; November 1871, £84,270 2s. 6d. In 1869, the sugar duty was at double the present rate.—*Scotsman.*

EXPORT OF STEAM-PLOUGH MACHINERY.—The advancement in agriculture in the West Indian colonies has been somewhat marked of late, and the introduction of steam machinery is becoming more general. Several shipments have been made recently from the Clyde to the English islands, and the ship Antigua has sailed with 60½ tons of steam-plough machinery on board, valued at £2560, for Trinidad.—*Scotsman.*

THE PROGRESS OF THE BEET SUGAR CROP.

The progress of the beet sugar manufacture is marked by a weaker and weaker density of the juice. The beets are so poor, especially in the North, that it recalls the gloomy season of 1857-58. The only advantage possessed by the present is that the juice is easier to work. But the fact is, there is plenty of juice, but very little *masse cuite*. The yield will therefore be very inferior, not only in sugar but in molasses.

Some factories will terminate their rasping at the end of the present month. The usines in the North are always the least stocked with beets. In the *arrondissement* of Valenciennes five or six factories had finished at the commencement of the month. At the time we write ten more will be in the same position. In short those factories which will be at work in January will probably be few.—*La Sucrerie Indigene, Dec.* 20, 1871.

NOTICES OF BOOKS, &c.

The Coolie in Demerara. A few words upon "The Coolie—his rights and wrongs. By the Author of Ginx's Baby." By West Indian.

London: The European Mail Office, 44a, Cannon Street. 1871.

This pamphlet, which appeared in the form of a series of letters to the *European Mail*, is designed to correct what the author deemed some exaggerations and misrepresentations contained in Mr. Jenkins' work.

The writer thinks thet the author of "Ginx's Baby" wrote his book on the Coolie with the object of convincing the two kindred philanthropical societies whose brief he held "that there are evils connected with the system of immigration into Guiana which fully justified the employment of his services to examine and expose." But it should be remembered that Mr. Jenkins' boook appeared piecemeal, in a popular magazine, and that probably the articles were written at the time when the things he writes of were then under his observation, and not after his return, which will account for the modifications apparent in Mr. Jenkins' views between the first chapters and the last. Great part of the occasional exaggeration is also due to the style of the author of "Ginx's Baby,"—somewhat too inflated and "popular" (or sensational) for so important a subject as the question between the Coolies and the Planters of British Guiana.

There is no doubt but that despite Mr. Jenkins' professions of impartiality the views of the partisan rather than of the enquirer are sometimes apparent. "The eye sees what it has the power to see," and Mr. Jenkins as the representative of the two societies named could scarcely be expected to see everything in the same light as a "West Indian" Planter. The writer of the pamphlet under notice has done well to point out passages which are likely to mislead the public mind in Mr. Jenkins' book, though in some instances what the latter wrote in his earlier chapters is corrected by subsequent observations, as "West Indian" himself points out: for instance—

"Very serious objection may be taken to Mr. Jenkins's description of the general condition of the Coolies, conveyed in the following sentences:—'Take a large factory in Manchester or Birmingham, build a wall round it, shut in its workpeople from all intercourse save at rare intervals with the outside world; keep them in absolute heathen ignorance, and get all the work you can out of them, treat them not unkindly, leave their social habits and relations to themselves as matters not concerning you who make the money from their labour and you would have . . a sugar estate village.'

"Now let us analyse this paragraph and endeavour to see whether it contains a modicum of truth. First, with regard to the comparison to a Manchester factory walled around. Our author is answered out of his own mouth—'we are passing cane-fields and at length turn sharp off the road—no fences or gates here—up an indifferent avenue of tamarinds: seeing on the left the ranges of immigrants' dwellings . . . on the right the overseer's house and hospital, pulling up at length opposite a garden blooming with splendid shrubs and flowers.' This 'walled isolation' is also illustrated by the fact that the Coolies are under ordinary circumstances allowed to go without question two miles from the estate (to allow them to wander at will and become vagrants, would be ruin to themselves as well as to their employers). The Commissioners state (p. 76) that there is no doubt, that as a rule, leave of absence is not refused to a steady workman, when he applies for it."

Although it is unlikely that Mr. Jenkins's book will have the effect of spreading much misconception with regard to the treatment of the Coolie in British Guiana, yet those who have read *The Coolie, his Rights and Wrongs*, would do well to read the pamphlet by *West Indian* as a corrective.

Free Trade in Sugar. Dedicated to the Cobden Club. By John Benjamin Smith, Esq., M.P.

London: Unwin, Brothers, 24, Bucklesbury. Price, Sixpence.

This pamphlet is intended to advocate a uniform duty on sugar, as opposed to the present scale. Why it has been written or published at the present time it is difficult to say, as it contains nothing new in the way of argument or illustration.

The dedication to the Cobden Club is certainly somewhat striking; not because it is appropriate by any means. Mr. Smith calls those of the members of the club who uphold the uniform duty on sugar, "Recreants," on what ground it is not easy to imagine, as the term is equally applicable to the great economist, whose name the club bears; Mr. Cobden, as is well known, having supported a uniform duty on sugar, both in and out of Parliament. Although Mr. Smith was, as he states, "the first chairman of the Anti-Corn Law League," this gives him no right to apply such an offensive epithet to gentlemen equally disinterested, and quite as able to form a correct opinion as himself.

As regards the pamphlet itself, it would be useless to go over its threadbare arguments and unsupported assertions. A considerable portion of it is occupied by tirades against refiners, or as he terms them, pieces makers, which would lead to the belief that the writer had drawn his inspiration from the *Produce Markets Review*." For example:

"One is struck with astonishment that it has been possible for a small body (numbering only about 100) calling themselves *sugar refiners*, but more properly styled *sugar spoilers* for whom there is no necessity, and who are the creatures of a classified scale of duties—to have been permitted by law for so many years for their own sole benefit, to deprive the people of this country of wholesome sugar, and to force by means of prohibitive duties on good sugar, and a bounty on their own re-made sugar, the almost exclusive use of sugar deprived by their process, of its natural honied sweetness. Such rubbish do the piece makers turn out in some cases, that it has to be scented and flavoured with Vanille lemon oil and other substances before it can pass into consumption. At the best pieces are simply decolorized brown sugar, more or less injured by the process to which it is subjected to effect the change."

As a specimen of style and argument the above extract will suffice. If a uniform duty is ever substituted for the present scale, the change will not be attributable to such lucubrations as the pamphlet to which Mr. J. B. Smith has given the sanction of his name.

Correspondence.

To the Editor of "The Sugar Cane."

Sir,

Your correspondent S, who deplores the loss of weight sustained by his sugar on the homeward voyage from Jamaica, may at least console himself by the belief that he is relatively better off than some of his compeers who adhere to the battery process in making muscovado.

Below is an abstract of a table of colonial and landing weights of sixteen shipments of sugar from the west coast Demerara, supplied by John A. Tinne, Esq., to the House of Commons Committee on the sugar duties in 1862, in which the loss is shown to be 13 per cent.

No. of Hogsheads.	Weight in Demerara. cwts.	qrs.	lbs.	Weight in Liverpool. cwts.	qrs.	lbs.
52	1052	2	18	958	1	20
41	838	1	17	741	1	14
25	509	3	13	465	0	6
43	914	1	13	767	3	0
100	2118	1	27	1812	2	16
80	1642	0	15	1478	3	14
82	1654	0	24	1482	0	11
90	1986	2	19	1654	3	13
114	2446	3	6	2128	0	10
75	1519	2	13	1374	3	19
133	2705	3	5	2389	2	11
100	2085	3	8	1831	2	17
53	1088	0	7	973	0	12
121	2560	0	6	2123	3	15
35	704	2	12	653	2	24
144	3129	1	5	2632	0	26
1228	26,956	3	12	23,468	1	4
	23,468	1	4			

Total loss on voyage.. 3,488 2 8 = 13 per cent.

In another case the loss on sugar shipped from the Leeward Islands amounted to 17½ per cent. To find the total absolute loss, the drainage between the Queen's beam and the consumers' scales must be added, which includes that in the bonded warehouse, and also the loss between the curing house and the shipping weight at the colonial port; these, together with the loss on board, will on the average amount to 20 per cent.

The causes suggested by your correspondent may have some connection with the loss, but it is now generally admitted that the long continued heat of the battery process is the chief cause of the deliquescence resulting from the change of pure sugar into uncrystallizable, and this appears the more probable when the drainage from sugars made by this process is compared with that from concrete, the whole process of the manufacture of which is effected in less than one hour.

In the table at foot, of the shipping and landing weights of the whole of the concrete received during last season from the estates of Belvidere, Bath Lodge and Greencastle, in the island of Antigua, the average per centage of drainage is shown to be under 3 per cent., this may appear very extraordinary when it is remembered that no molasses is extracted from the juice before or after potting, yet in some cases the loss has been even still less than this. As regards the concrete it may be stated that what is called in the table the shipping weight is in fact the weight on the estate, and it may also be added that there is no loss after arrival in this country.

I am, Sir,
Yours truly,
R.

Ship's Name.				Shipping Weight.			Landing Weight.			Loss.			Loss
	hhds.	trcs.	brls.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	p. c.
Lancastria..	153	0	208 ..	3976	3	5 ..	3794	1	25 ..	182	1	8 ..	4·6
Napier	111	15	104 ..	2804	2	8 ..	2722	0	18 ..	82	1	18 ..	2·9
Westwood..	61	18	71 ..	1705	3	10 ..	1666	0	21 ..	39	2	17 ..	2·3
Comet	91	3	91 ..	2272	0	27 ..	2198	0	21 ..	81	0	6 ..	3·5
Red Jacket.	52	0	26 ..	1198	0	17 ..	1170	2	14 ..	27	2	3 ..	2·3
Lancastria..	78	0	132 ..	2120	0	1 ..	2076	3	4 ..	43	0	25 ..	2·0
Mercatir ..	92	0	108 ..	2283	2	11 ..	2224	0	4 ..	59	2	7 ..	2·6
Napier	29	0	8 ..	614	3	18 ..	601	1	12 ..	13	2	6 ..	2·2
Westwood..	99	2	7 ..	2056	0	16 ..	1997	0	4 ..	59	0	12 ..	2·8

Average of per centages..2·8.

NATAL AS A SUGAR PRODUCING COLONY.

To the Editor of "The Sugar Cane."

Sir,

In an article from the *Commercial Gazette* in your December number on the "Last Season's Sugar Crop in Mauritius" the following passage occurs :—

" With Natal so near it is matter of surprise that we now send any sugar to the Cape. That Natal, after so many years' trial cannot produce sufficient sugar for the consumption of the Cape does not give us much confidence in our neighbour as a sugar producing colony."

That the conclusion which the Editor of the *Commercial Gazette* draws from the fact that Mauritius sugar is in request at the Cape, is an erroneous one will be seen from an extract taken from a letter in the October summary of the *Natal Mercury*, which shows that it is not sugar producing power, but means of transport which are wanting to make Natal a formidable competitor with Mauritius in other markets beside that of the Cape. At present the diamond fields stand in the way of both public and private enterprise (not immediately connected with them) in all the South African Colonies; but the Natal Colonists, it is to be hoped, are well aware that the way to wealth is much shorter and infinitely pleasanter, through the culture of their fertile soil, in their fine climate, than in rushing to a distant desert to dig for diamonds:—

"In your leader of the 7th current, you take a "Mount Pisgah" view of our future, when you say that some of us may yet live to see the day when half a million tons of sugar will be produced in Natal. If you look into your issue of the 3rd January, 1855, you will find the prediction of four ship loads of sugar leaving our harbour daily, which will be little short of the half million tons now within the range of the prophetic eye. In the same year (1855) you will find by reference to your issues of February and August, that it was then suggested that the growth of the cane with very great advantage, might be made a separate branch from the manufacture of the sugar. You will also find that it was then suggested that the clearest and the best, and consequently most abundant crops of sugar would be obtained in Natal as in Jamaica, from hill plantations, instead of from the humid valleys and low-lying plains. You will find, too, the results of experiments made in the growth of the cane at elevations embracing the whole area to a distance of fifty miles from the sea, and that they were then pronounced to be highly satisfactory and promising. If you turn from the pages of the *Mercury*, to the evidence given before the Committee of the Legislative Council sitting on railways, in 1864, of which you were a member, perhaps you may in a moment of compunction be led to say with the Egyptian butler of old, "I do remember my faults this day." In that year you were told in the most emphatic terms, that the collective wisdom of the colony would be greatly to blame if it did not take immediate steps to encourage industry by providing proper means of transport, and that those steps should be first taken where they were then most required. With an emphasis that could not be misunderstood, and defiant of all the jealousy that would be incurred elsewhere in the colony, the coast was named as imperatively demanding and absolutely requiring a railway on account of its extraordinary capacity to produce materials for the European markets, and the County of Victoria was specified as in immediate want of such facilities as only a railway would give. When we learn that there are now in the mills of that county hundreds of tons of sugar actually bagged up and ready for shipment, and that much more is in prospect before the crushing season is over, and that there is not an offer at any price from any carrier to take an ounce of it to the seaport of the colony, so that the planters are thinking seriously of getting up some scheme by Bazley's derrick and endless wire rope, of shipping their produce from the beach—surely it will be admitted that this emphasis was not too emphatic. We hear of the vast extension of railways in India, and our hearts are beating with envy that our own prosperity is not on the same vast scale, and it the more overwhelming when we know that with all the cry of "cotton" from the east, the yield per acre of marketable staple is only from 60 to 80lb s.

"With regard to coffee also, it is well known that the yield per acre is equal to that of the most highly-famed countries where that plant is grown. In the face of experience so full of promise, it is surprising that so little has been done in promoting the most economical means of transport on the coast. Every succeeding wagon for the last twenty years turns up the same deep sand, and sticks fast in the same tenacious mud, the wear and tear of the cattle and gear, and the delay of the produce on the road appearing to vie with each other in causing the greatest possible amount of vexation and loss."

Some of your readers, both in Natal and other parts, may be interested in the above if you think it worth insertion.

Yours, &c.,

L. N.

TO THE EDITOR OF "THE SUGAR CANE."

SIR,

It is an enigma beyond my ability to solve, that the earlier, or proximate process, in the manufacture of sugar from the cane, is studiously avoided by public expositors; as a consequence, it remains in much obscurity. When men do refer to it, they involuntarily get into the old groove, "to tell the twice told tale." I have recently been among the many who listened to the interesting and popular "Cantor Lectures," at the Society of Arts. The subject was "On the Manufacture and Refining of Sugar." What was said, was undeniably correct; what was done, by way of experiments, was appropriate, neat, successful. The expectant many were candidly told at the onset, that "the part of Hamlet would be left out by particular desire," or, more correctly, "any reference to the treatment of cane juice would be but cursory, as, all he—the lecturer—knew of that process, was what he had gleaned from books." Here was a fine opportunity lost to the interest of the planter, when the treatment of the juice, its composition, properties, and products, might have been scientifically analysed, and practically elucidated, with the impedio removed out of his way, and the "how to do it" made plain before him. Alas, all this was blank.

Planters will smile, when told, that the lecturer perpetuated the old, well-worn error, for which "the books," of course, are responsible; that the cane contains 90 per cent. of *juice*. Granted, that the cane contains 90 per cent. of *moisture*, as tabulated in the chemists' analysis, what then?

That it contains 90 per cent. of *juice*, is in the planter's estimate, a fallacy. If the latter obtains 60 or 65 per cent. of juice, he is content, and very properly so. For, he is only too glad to let slide the remaining 20 or 30 per cent. of *moisture*, which would be but an impediment to success. They who have examined a section of the newly cut, ripe sugar cane, know, that the *juice* only, is of practical value, and that is found in *the fragile cellulose portion*, the soft pith of the cane, and all that *moisture* which is in the harder portion, is worse than useless, because *it can contaminate the remainder, and impurify the sugar-product* to reduce its value. Chemical analysis, and every day practical experience, offer independent evidence in confirmation. The Indians have a well known rough and ready way of satisfying themselves, about the amount of pressure necessary in practice, to get all the *juice* they want, by simply opening the megasse as it issues from the mill, biting out some of the pressed cellulose, and chewing it. If they detect no sweetness they are satisfied, treating the harder portion of the cane with the contempt that worthlessness merits, although it may possibly contain the remaining 20 or 30 per cent. of *moisture*. I will pass by any suggestions now about a new and simpler form of sugar mill, with which I am prepared, the better to indulge a remark or two about the evaporating pans.

We had an excellent description of what Dr. Ure facetiously denominated "the frying pans," and your number for December also affords a complete illustration. *Esto perpetuo* seems stereotyped on every mode, and on every appliance connected with this manufacture, and the "frying pans" are not exceptions to the rule.

Why not boldly reverse the order of their arrangement in relation to the fire? Why not put the largest pan, that first receives the juice, over, and the finishing pan the furthest from the fire? (I have no affection for the *French* terms, "grande," "teche," &c., where *English words can be sufficient*). Am I proposing too great an innovation, going too far out of the old groove? Does the absurdity make anyone laugh at the extravagance of such an idea? Then prove, if you please, that the direct intense heat of the fire communicated to the finishing pan over the fire, is conducted through the semifluid, agglutinated mass of sugar, as rapidly as it is conducted through the cast iron of the pan. If not—which is the fact—you realise the "frying pans" of the venerated Doctor; you have caramel instead of sugar for a product, and are not to be envied for your loss.

The better to carry this *reverse order* of the arrangement of the evaporating pans beyond the reach of "idle opinion," we can raise it high on every day well known fact. *Ex gra.* The best quality of sugar that comes to and from Manilla—which, of course, is the capital of the island of Luzon—is brought from the province of Pampanga, and, of this, *the superior quality, commanding the best price*, is supplied from the largest estate in the province, which belongs to Senor Don Felino Gil. What is more germane to our subject, is the fact that, Don Felino himself has arranged all his pans, these several years past, to my knowledge, as I have here suggested, and *in the reverse order* to that in your diagram page 621. I have seen the second and following pans kept on the boil, and the first preserved at about 180° to 200° F., to complete the scumming. Such simple, well known facts put mere routine and all its mysteries, into their proper places.

I had almost forgotten the able lecturer for the moment; but whilst cane-sugar suffered decapitation, beet-sugar was favoured with explanation to completeness. It occurs to me *en passant*, as just possible, for capitalists to be led into error by a portion of truth. Far be it from me to convey the shadow of an idea, that can fall adversely, directly or indirectly on the talented lecturer; on the contrary, he got through his task, so far as he knew, and knew well, with considerable *eclat*, and integrity of purpose. Whilst he was able to show clearly, and explain the various stages in the process of beet-sugar manufacture, and *produced a splendid product*, he almost omitted to tell us—he may not have studied the fact—that the planter does not realize more than one-third, on an average, of the sugar contained in the juice of the cane, notwithstanding its ability to yield more under proper treatment. Then comes the question, in what pecuniary position will a reduction of the price of sugar, land the beet-sugar manufacturer, after expending his capital on plant, when the product of the sugar-cane is doubled and cheapened, as it can be any day? Thus we may see how the hesitation at improvement of cane sugar, surrounds its victims with embarrassment. The proposition of a novelty shocks the nerves; and the prejudices of men who are content with the old groove, are prone to compare every proposition with that which is rotten, as with perfection—a perfection that secures the loss of more sugar than they sell. Men must be educated up to the required practicability, and your excellent Magazine is nobly doing its duty in that direction. There must be a movement soon in the interest of the planter of sugar-canes.

I read the gentle hint of your correspondent S. He appears disposed to profit by my experience; may I assure him that shipwreck, &c., impel me to a similar conclusion, at least, for the present.

Your obedient Servant,
W. EATHORNE GILL.

4C, Mortimer Road,
De Beauvoir Square, London, N.

To the Editor of "The Sugar Cane."

Sir,

You have occasionally given place to some of my lucubrations, so I venture to send you a short account of an experiment made with the Concretor trays during our present season's boiling.

The experiment was one which I was in a manner forced into making, by an accident by which the whole of our upper tray and part of the lower one became warped. The accident was due in the first instance to the excessive use of wood as fuel, especially near the end of the day's work, and to the neglect of the prolonged use of water on the trays after the fire was drawn, until the furnace cooled. The warping was so great that I was compelled to block up the port from tray to tray, to deepen some of the compartments and cause the liquor to flow over the trays at their junction, otherwise it would have been impossible to work at all. Of course this is but a partial and temporary remedy, but by its means we have ascertained that when a comparatively great depth of liquor is kept on the upper tray we are enabled to skim much more effectually than before, and consequently our sugar has been cleaner, more uniform, lighter coloured, and free from unpleasant taste and smell.

We have made thus far about 2½ tons of sugar per acre of cane, which, though less than last season, is still so far satisfactory that despite some drawbacks my mill is generally considered to be the most successful yet started in the colony. Yours, &c.,

J. C. NEILD.

NEW PATENTS.

FROM THE MECHANICS' MAGAZINE.

1386. J. V. Day, Buchanan Street, Glasgow, Lanark, North Britain. *Refining of raw sugar.* Dated May 23, 1871.

Raw sugar dissolved in water with phosphate of soda or other chemical equivalent, is boiled down for crystallization without filtration, the mixture being put into a centrifugal machine to separate the crystals from the syrup, and the crystals put through a wash to form them more perfectly. The process is repeated until the syrup is too weak to crystallize.

1390. J. W. Smith, 2, Warrington Crescent, Paddington, Middlesex. *Fermenting worts for distillation or vinegar making.* Dated May 24, 1871.

The novelty consists in the production by fermentation of a greater and better quality of yeast without diminishing the yield of spirit or vinegar.

MAURITIUS.

(From Licht's Monthly Circular.)

EXPORTS FROM 1ST AUGUST TO 17TH OCTOBER.

	1871.	1870.	1869.
	Tons.	Tons.	Tons.
To England	8,775	2,777	6,886
,, France	6,692	2,159	3,968
,, Australia	4,268	6,736	7,624
,, New Zealand	1,056	720	1,837
,, Bombay	9,007	7,211	10,883
,, Cape of Good Hope	130	814	293
,, Other Ports	1,188	148	215
Total	31,116	20,565	31,706

HAVANNA AND MATANZAS.

EXPORTS FROM THE 1ST OF JANUARY TO THE 4TH OF NOVEMBER.

	1871.	1870.	1869.
	Tons.	Tons.	Tons.
To United States of America	176,510	180,495	187,225
,, Great Britain	64,396	174,171	153,436
,, Spain	45,060	57,812	45,854
,, France	11,080	43,960	47,194
,, Northern Europe	8,812	10,661	15,265
,, Southern Europe	548	3,410	3,218
,, Other Ports	3,284	8,096	6,280
Total	309,690	478,605	453,472
Stocks in Havanna and Matanzas	33,454	22,284	32,614

REUNION.

EXPORTS IN THE SEASON

	1870-71.	1869-70.	1868-69.
	Tons.	Tons.	Tons.
To Nantes	7,188	15,020	6,475
,, Bordeaux	..	..	611
,, Marseilles	2,500	4,526	2,455
,, Belle Isle (for orders)	7,197	16,606	11,708
,, Cadiz	987	1,516	1,146
,, Australia	5,661	4,853	3,634
,, Persian Gulf	..	134	..
	23,533	42,655	26,029

In the five previous seasons	1867-68	1866-67	1865-66	1864-65	1863-64
	Tons.	Tons.	Tons.	Tons.	Tons.
Were exported from Reunion.	58,100	52,966	48,085	39,916	35,913

ESTIMATED PRODUCTION OF BEET-ROOT SUGAR ON THE CONTINENT OF EUROPE COMPARED WITH THAT OF TWO PREVIOUS SEASONS.

(From Licht's Monthly Circular.)

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
France	290,000	289,083	289,324
Germany (Zollverein)	195,000	262,986	217,192
Austro-Hungary	160,000	182,280	151,353
Russia and Poland	110,000	135,000	132,500
Belgium	50,000	55,739	43,552
Holland and other countries	25,000	17,500	12,500
Total	830,000	942,588	846,421

STOCKS OF SUGAR IN THE CHIEF MARKETS OF THE WORLD ON THE 1ST NOVEMBER, IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	1871.	1870.	1869.
United Kingdom	129	165	142
France	55	57	60
Holland	28	23	25
Germany (Zollverein)	16	19	21
Six other depôts	6	4	4
	234	268	252
United States	96	82	101
Havanna & Matanzas	33	22	33
TOTAL	363	372	386

CONSUMPTION OF SUGAR IN EUROPE AND THE UNITED STATES, FOR THE YEARS ENDING 31ST OCTOBER, IN THOUSANDS OF TONS.

	1871.	1870.	1869.
United Kingdom	679	690	619
France	319	321	300
Germany (Zollverein)	228	216	209
Holland	25	30	27
Six other Countries	118	106	100
	1,369	1,363	1,255
United States	508	472	410
TOTAL	1,877	1,835	1,665

SUGAR STATISTICS—GREAT BRITAIN.

To 16th December, 1871 and 1870. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1871.	Total, 1870.	London.	Liverpool	Bristol.	Clyde.	Total, 1871.	Total, 1870.	London.	Liverpool	Bristol.	Clyde.	Total, 1871.	Total, 1870.
British West India	12	1	1	9	23	28	104	17	15	69	205	182	106	17	14	69	205	166
British East India	4	4	..	..	8	16	7	8	..	..	15	15	18	6	..	..	24	17
Mauritius	3	..	..	1	5	4	10	2	6	5	23	30	9	2	6	4	22	32
Cuba	4	1	..	6	11	14	8	5	13	29	54	150	7	7	14	26	54	156
Porto Rico, &c. ..	1	3	..	1	5	8	4	14	2	8	27	41	6	13	3	8	30	37
Manilla & Java ..	12	8	..	..	21	44	21	17	7	5	49	48	36	22	6	4	69	49
Brazil	..	9	1	5	15	18	1	36	6	18	61	66	1	37	6	17	61	60
Beetroot, &c.	5	1	..	9	16	13	35	20	10	75	140	70	35	20	11	75	140	65
Total, 1871 ..	41	28	3	31	103	142	189	118	59	208	574	602	217	123	60	203	604	582
Total, 1870 ..	72	36	6	29	39decrease		197	137	67	201	28decrease		201	126	67	188	22increase	

THE SUGAR MARKET IN 1871.

The year opened with considerable animation in the sugar market, and during January an advance of 2s. per cwt. was obtained on rates which had improved very much towards the close of 1870. Prices of loaf sugar during this month were unprecedentedly high, in consequence of the French refineries being closed on account of the war with Germany and the inability of the London refiners to supply the demands of the country; but immediately after the capitulation of Paris a great decline at once took place in refined, which was not without effect on the raw sugar market. In March the insurrection in Paris tended further to depreciate the value of raw sugars, by increasing the export of beet sugar from France to this country, and although the refineries in Paris were stopped, there was no revival in the price of loaf sugars, but rather a further reduction.

About this period the probability of greatly diminished supplies of colonial sugar, especially of Cuba and Mauritius, began to be recognised. But the very large imports of beet sugar from the Continent, for a while counteracted the effect which the prospect of diminished supplies from the colonies would have had on the market, and prevented any advance in prices. When, however, stocks showed a gradual and regular decrease, and deliveries continued to increase, the market took a firmer tone, and from April to the end of the year the average duty-paid price of refining qualities of British plantation sugar remained uniformly above that of the year 1870, the advance being on the average about 3s. per cwt. In July the lowest point of the market for these sugars (28s. 6d. per cwt.) was reached, yet this was 2s. 6d. per cwt. above that of the same date in 1870. The fluctuations in the average value of this description of sugars have not been above 3s. per cwt. during the whole of the year, the highest point being 31s. 6d. on the 23rd of December. This is the more remarkable since there has been considerable variation in the price of some other sorts.

In the year 1870 low to middling raw sugars were greatly depressed and below their value compared with the better class of sugars: during the past year the relative values have been more nearly maintained; it may be noted that the average price of Bengal jaggery has advanced 6s. per cwt. from the lowest point.

There has been an increased demand by refiners for Fryer's concrete, which has generally fetched good prices compared with muscovados.

The unusually large breadth of beet sown on the continent of Europe, especially in France, and the general appearance of the crops in July and August, led to estimates being made of the present season's production very largely in excess of last, and this prospect undoubtedly tended to keep down the raw sugar market in this country. Since the commencement of the rasping season, which has shown that the beet is universally very poor in saccharine, the estimates of the production have gradually declined, until the latest calculation places it as more than 100,000 tons below the yield of season 1870-71. These later estimates have not been without influence on prices.

The year closes with firm markets for all sorts of raw sugar. Very little of any description now remains in the hands of importers.

PROSPECTS.

There is more than ordinary difficulty in judging as to the future. The crops of colonial sugar, of Cuba especially, are expected to be generally above the average: on the other hand, that of Louisiana is reported to be much below last season's, and as we have seen, the continental yield of beet sugar will be very greatly deficient; whilst the aggregate consumption will probably continue to increase. As the season advances, the large arrivals of colonial sugar will no doubt affect the market to some extent, but there seems no reason to look for any material change in the value of sugars for some time to come.

THE

SUGAR CANE.

No. 31. FEBRUARY 1, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

For Table of Contents, see opposite the last page of each Number.

ON THE MANUFACTURE OF SUGAR FROM THE SUGAR CANE, AND THE MACHINERY EMPLOYED THEREIN.

(Continued from page 28.*)*

We placed the Concretor first in our list of apparatus for the concentration of cane-juice, because, as generally used, it is the least pretentious of the machines employed for this purpose. All others profess to separate the crystallizable sugar from the molasses; the Concretor makes no such profession, but assumes that this operation can be effected more cheaply by the refiner than by the planter. It therefore offers the simplest method of manufacturing sugar on the plantation.

Next in order would stand the Jamaica train, to which we have already devoted a paper, and which, therefore, we need not further describe. This method of manufacture, though transgressing every rule which ought to be observed in the manufacture of sugar, has at least the merit of simplicity. A less objectionable form of the Jamaica train is that in which the tayche alone is hemispherical, the other portions of the apparatus consisting of square flat-bottomed vessels. Where these are shallow, they afford a much larger proportion of heating surface, as compared with the quantity of liquor they hold, than can be obtained in the ordinary hemispherical coppers. In some trains of this description sluice valves are so arranged between the various pans that the liquor can run from one into the other instead of having to be ladled by hand.

The tayche must in any case be hemispherical, because no other form of pan can be so quickly and so entirely emptied of its contents.

Though, as we have explained, trains of flat-bottomed pans are less objectionable than those of hemispherical pans, they yet possess all, or almost all, the same faults, though in a modified degree. They still expose the syrup, especially when at a high density, to intense heat, and keep it exposed to a high temperature for far too long a time. It is obvious, therefore, that, though they may be capable of producing better sugar than the old-fashioned hemispherical pans, yet we must not look for very good results from them. They also have faults peculiar to themselves, as for instance, greater liability to damage if left exposed to heat when empty.

Next in order to these modifications of the Jamaica train, comes those pans in which the juice is boiled down in the open air, but by means of surfaces heated by steam instead of directly by the heat from a furnace.

Many people appear to think that immediately they begin to evaporate their juice by means of steam, all chance of injury to it from heat disappears. A little reflection will show that this is not the case. True, the temperature of the steam used for evaporating is much less than that of a furnace, yet the fiercest furnace will not raise the temperature of water boiling freely in the open air above 212° Fahrenheit, and no arrangement of steam-heating surfaces will make it boil at a less heat than this.

Thus we see that we cannot get the juice to boil at a lower temperature when we heat it by steam than when we boil it over a furnace. Yet it is the high temperature of the juice itself which we have to fear. It is therefore obvious that if it takes us as long to concentrate a given charge of juice in a steam pan as it would to evaporate it over a furnace, the injury in the one case will be exactly the same as in the other. Still steam pans do possess very considerable advantages over those heated by open fire. In the first place the proportion of heating surface to the contents of the pan can be very largely increased; not only can the pan be steam-jacketed (the steam jacket representing the whole surface which could be heated by direct fire), but a great quantity of heating surface may be introduced into the interior of the pan, either in the form of coils of steam pipe, or in some other convenient way. This increase in the proportion of heating surface to the contents means (supposing the steam used to be of sufficiently high temperature) that the juice will be more quickly concentrated: in other words, that it will be exposed to heat for less time, and, therefore, less injured than in an open pan. Another great advantage possessed by the steam pan is, that the steam can be turned off and *all heat withdrawn* the instant the juice is sufficiently concentrated. The burning and charring of sugar which so frequently takes place in the Jamaica train, while the tayche is being emptied, and the contents of one copper transferred to another, is thus entirely avoided.

The disadvantages to set off against these advantages are, first, greater cost of apparatus, for first, not only is the pan itself costly, but it also needs boilers to provide it with steam; and, secondly, greater consumption of fuel, arising from the evaporation being effected indirectly instead of directly.

The different arrangements of steam pan in use are endless. The various forms of steam clarifiers are examples, though in these the proportion of heating surface to the contents is much smaller than it should be in a steam pan intended to concentrate cane-juice.

Perhaps the Aspinall pan is the best example of steam pan intended for this purpose. In this arrangement the pan itself is not usually steam-jacketed, a sufficiency of heating surface being otherwise and more cheaply obtained. The heating surface consists of a square (or round) box usually of copper, having a flat top and bottom; these are connected together by a number of pipes, placed as close together as is consistent with the requisite strength of top and bottom plates, and with the free circulation of steam between the pipes. Each of these pipes makes a sound joint with the top and bottom plates, and thus forms an open pipe running through the box. Steam is admitted into the box, and thus heats the top, bottom, and sides of it, together with the outside of the pipes. This steam box is then fixed a few inches above the bottom of the pan, so that the juice to be evaporated can flow freely around and under it, as well as through the tubes in the steam box itself. It will be seen that this arrangement affords a means of getting a very large heating surface into a pan of moderate size.

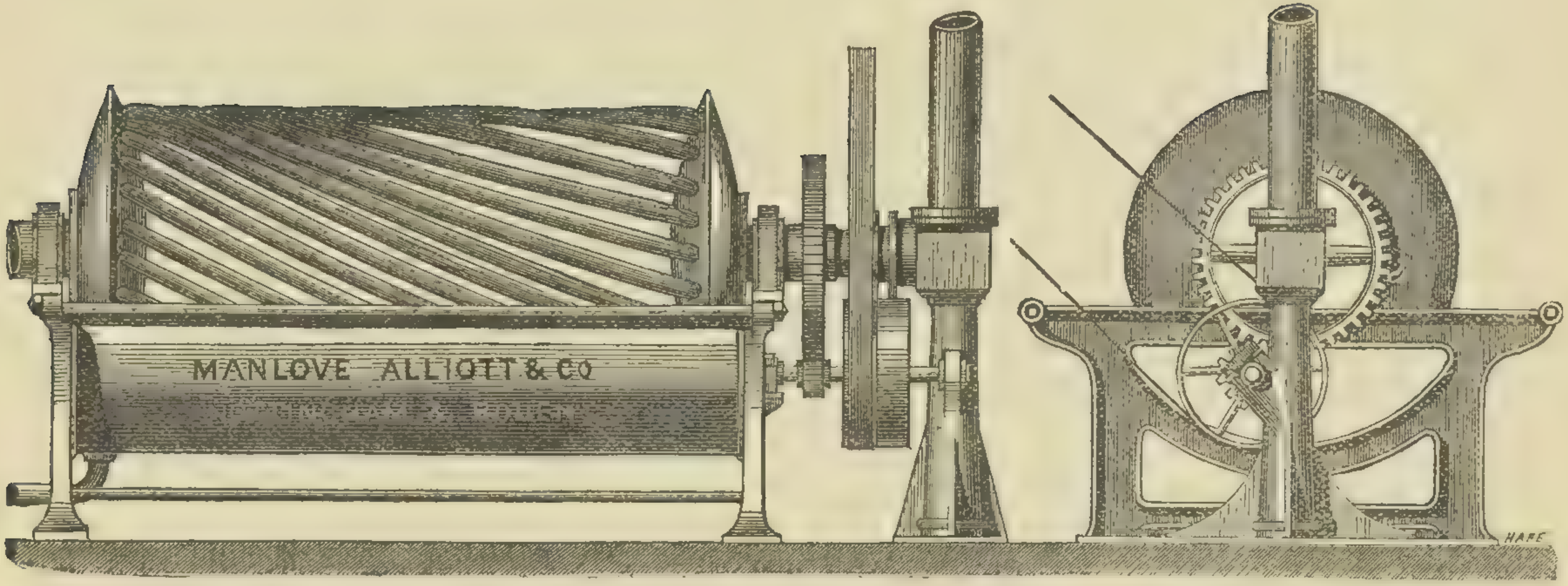
Steam pans are frequently employed to finish syrup which has been partially concentrated in the Jamaica train; when thus used they enable the planter to avoid the burning and charring of sugar which occur each time the tayche is emptied.

The next process of manufacture which we shall describe is that in which the juice is evaporated to a density of say about 25° to 30° Baumé in the tayche, and then the concentration is finished in some kind of open air low temperature pan.

There are various arrangements of these low temperature pans in use. The first pan of this kind brought into general use was that patented by Mr. Gadesden, of London, and bearing his name.

It is so well described by Dr. Evans that we quote his words respecting it:—

"This gentleman's apparatus consists of an iron or copper pan, having nearly the form of the half of a hollow cylinder in which is placed a drum or wheel adapted to the shape of the vessel, and formed of a number of metal rods so arranged that the evaporating surface given to the syrup is increased as much as possible. The wheel, half its circumference being immersed in the syrup, is kept constantly revolving, so that by exposing fresh portions of the heated syrup to the action of the atmosphere at each succeeding revolution, the evaporation of the aqueous particles is rendered more rapid than it would otherwise be, while the temperature is at the same time in corresponding degree reduced. The time required to take off a skip in a pan containing one ton of sugar, varies from two and a half to four hours, and the temperature of the syrup ranges from 150° to 110° Fah. From the principles upon which this method of concentration is based, it is evident that its successful working will depend upon the degree of dryness of the atmosphere, THE WETZEL PAN.



and upon the rapidity with which the air passes over the surface of the syrup. The apparatus should therefore always, when it is practicable, be placed at the windward side of the boiling house; at all events it should be beyond the influence of the vapours which arise from the evaporating vessels."

From the above description, it will be evident that the Gadesden pan completes the concentration of syrup at a low temperature, and yet gives it ample time to crystallize; but it gets through its work slowly, and sometimes causes frothing of the syrups which is very troublesome.

The Wetzel pan is now much more used than the Gadesden. In it the metal rods of the Gadesden pan are replaced by copper pipes; these are firmly brazed at each end into hollow dishes of copper; these dishes and the pipes connecting them are heated by steam—usually the exhaust steam of the cane mill engine—passed through them. It is obvious that since in this pan the evaporating surfaces over which the syrup is spread are themselves heated by steam, evaporation will take place from them much more rapidly than it takes place in the Gadesden pan, while the temperature of the syrup is still kept very low by the rapidity of the evaporation. The best arranged Wetzel pan which we have seen, is one which we illustrate, constructed by Messrs. Manlove, Alliott & Co., of Nottingham.

In this pan it will be observed that the pipes are curved into a spiral instead of being straight, which is their usual form, this curvature avoiding the heating action in entering the syrup, which causes frothing, affords greater facility for the removal of the condensed water, and enables a greater quantity of heating surface to be got within a given space.

We might mention other arrangements of low temperature pan, but all are constructed upon the same principles, and we believe that none are superior to those we have described.—*British Trade Journal.*

(To be continued.)

THE ANALYSIS OF SUGAR AND MOLASSES.

[A TRANSLATION OF THE REPORT PRESENTED TO THE CENTRAL COMMITTEE OF THE SUGAR MANUFACTURERS OF FRANCE.]

(Continued from page 8.)

9. DETERMINATION OF THE ASH.—To incinerate the sugar, a small capsule of platina, 5 or 6 centimetres (about 2 inches) in diameter, is used. Before taring it should be made perfectly dry by being heated nearly to redness.

When the capsule is tared, 5 grammes of sugar should be weighed into it for assay.

On this sugar there must be dropped a little pure mono-hydrated sulphuric acid, care being taken to damp the whole mass of sugar with it uniformly. It is not needful to measure the quantity of acid exactly, but it is better always to use very nearly the same quantity, say 2 cubic centimetres. To facilitate the action of the acid on the salts, there must also be dropped, uniformly over the mass, a very small quantity of water, say one-fourth the bulk of the acid.

The capsule is allowed to stand nearly half an hour, to give time both for the strong acid to combine with the bases of the salts, and for the weak acids eliminated to be partly disengaged. In addition to the advantage of having all the salts regularly sulphated, this practice ensures on the commencement of heating much less disturbance in the capsule, the greater part of the gas being already disengaged.

The process of incineration is then commenced.

This operation may be conducted in a muffle furnace such as is used for the assay of gold and silver, or over a gas flame or spirit lamp.

When there are many determinations to be made, a muffle is always used; it is placed in a furnace heated by gas-burners; this goes by the name of "Wiesnegg's Muffle Furnace."

If gas is not to be had, it is necessary to heat the muffle by wood charcoal; but it is inconvenient. During the incineration, the muffle should be kept at a cherry-red; towards the end it may be made a little hotter.

Take hold of the capsule with a small pair of tongs, and, hold it within the entrance to the muffle, when it begins to seethe withdraw the capsule and place it on one side till the seething is exhausted, then replace the capsule at the entrance to the furnace, when it will again begin to bubble up, but not so violently as before: when it has ceased to do so, push it further into the muffle but not yet to the far end of it. At length, in about about a quarter of an hour, it may be placed at the back of the muffle. When the ash is quite white (which will generally be the case in three-quarters of an hour to an hour,) withdraw the capsule, when it has become lukewarm it may be weighed. It is not needful to allow it to cool long, in fact it will get cool enough while you are carrying it to the scales.

The capsule is again replaced in the far end of the muffle, and care is taken to be sure that it becomes of a cherry-red or even a little hotter; it is then allowed to remain there fifteen or twenty minutes, when it is again weighed. If exactly the same weight is found as before, the assay is finished; if there is any difference, even if it is only 1 or 2 milligrammes, it is necessary to return it to the muffle again. This is important because although the ash may appear to be very white, there may be some of the bisulphates which are difficult to decompose, for which reason it is recommended that the capsule be heated a little hotter towards the end, and even if the sulphates should be melted it is of no moment, the weight will not be changed by that.

The assay terminated, if there is for example 0 gr. 106 milligrs. of ash, one-tenth must be deducted from it, or what will be the same thing it may be multiplied by ·9: this will give 0 gr. 095 milligrammes of ash; multiply this by 100 it will give 9·5, which is then divided by 5 and 1·90 will represent the weight of ash per cent. of the sugar assayed.

When a flame is used instead of a muffle furnace, this flame may be produced by common gas or by alcohol.

If gas is employed a particular burner is used known by the name of Weisneg's burner, which is noted for the great heat given by it.

If alcohol is employed it needs what is called a double current lamp with constant level. In both cases it is needful that the platina capsule be placed on a small triangle and not on any support which would absorb the heat, it should be put in the top part of the flame in order that it may not be blackened by the smoke and because at this point the flame is the hottest.

The mode of making the assay is the same, the capsule must be heated very slowly at first and drawn away as soon as the contents begin to seethe, again heated carefully, then the full heat applied so that the capsule shall be of a cherry-red; if it is very light in the room where the determination is being made it will be needful to shade the capsule in order to see the colour of it.

10.—Calculation of the Results of Analysis.—Such are the three operations which constitute an analysis of sugar. Sometimes the uncrystallizable is determined if the sample contains any, but we will speak of this by itself.

The sugar which we have taken as an example then contains—

Moisture or water	1·50	per cent.
Pure crystallizable sugar	95·00	,,
Salts or rather ash	1·90	,,
Organic and other matters (by difference)	1·60	,,
	100·00	

To calculate the value of this sugar according to actual commercial usage, the amount of ash is multiplied by 5, thus 1·90 × 5 = 9·5, which is deducted from the saccharimetrical value thus, 95 — 9·5 = 85·5, and it is this figure which is called the net *titre*.

The standard which serves as the base in commerce is 88°, and each degree above 88° up to 92° is valued at 1 fr. 25 c., above that at only 1 fr.; below 88° each degree is valued at 1 fr. 25 c. The price of 88° being for example 60 frs. per 100 kilogrs., and the sugar in question being 2½° below 88°, its value is then 60 frs. less 2·5 × 1 fr. 25 c., or 60 frs. — 3 fr. 10 c., = 56 frs. 90 c.

We shall discuss further this method of calculating the value of sugar, we merely indicate here what is the actual usage.

11. Uncrystallizable.—We must now speak of a special assay which is often made of raw sugars and which consists in determining the quantity of uncrystallizable sugar which they contain.

In the first place, we must say in a few words, although it may now be well known, that the word uncrystallizable is not to be understood in its general meaning in the French language, but according to its special signification in the chemistry of sugar. Chemically what is meant by uncrystallizable sugar is a sugar which is not of the same chemical composition as the crystals of cane or beet sugar of which the type of purity is white sugar candy, the name has been given, in fact, because it does not crystallize.

But as we have said before, crystallizable sugar may be prevented from crystallizing by different foreign bodies which are mixed with it; it is actually in this case uncrystallizable, but it is never called by this name (which is specially reserved for decomposed sugar), but is simply in this case crystallizable sugar prevented from crystallizing.

Uncrystallizable sugar, chemically speaking, not being registered on the polariscope in the same manner as crystallizable, it appears useless to estimate it; not being counted in the above analysis as sugar, as water, or as salts, it will be found amongst those organic substances reckoned by difference.

But buyers (refiners) sometimes insist on its being specially determined, and assuming, right or wrong, that this sugar exercises a prejudicial action in their manufacture, they deduct its weight from the net *titre*, which has been calculated as above.

Not wishing to judge lightly whether this pretension is well founded or not, special practical experiments not having been made on the subject, we are bound to mention the fact, adding however that by the direct saccharimetrical assay the uncrystallizable has already been deducted in part from the net valuation, inasmuch as it exercises on the polariscope an inverse action to that of the crystallizable sugar, although in less proportion.

However we will now give the method of determining the proportion of uncrystallizable sugar.

This is a very delicate operation, because it is found in small quantities mixed with a large proportion of foreign matter; and the public analysts not having divulged their method, and the general method given in the chemical books producing only uncertain results, we believe it to be our duty to caution manufacturers against the established custom of computing and deducting this sugar, until more light has been thrown on the subject.

The determination of the uncrystallizable in raw sugars, without presenting great difficulties, necessitates certain precautions and a precise method differing slightly from that given in the works of chemists for this kind of analysis.

In these manuals we have to deal in general with the assay of uncrystallizable sugar existing in tolerably large proportions in a clear liquid; the methods indicated in this case will not give proper results when carried out in the analysis of sugars containing for example 0·1 per cent. of uncrystallizable, or one-thousandth part, in a sugar coloured and impure.

From the method which we give, results the most exact and trustworthy may be obtained.

The copper solution which we use is one of those mentioned in the books. The difference is not in this; only it is very important to choose one which may be carried to the boiling point with the addition of at least twenty times its volume of water without any of the oxide of copper being precipitated. We have, in fact, found [copper] solutions sold, which either from their unsuitable composition or from having become modified, have presented this phenomenon: one of these amongst others, when diluted with only ten times its volume of pure water, and boiled, was completely decoloured, and precipitated all its copper. This would then inevitably cause the presence of uncrystallizable to appear in whatever sugar was under analysis, whether it contained any or not, and would show excess in sugars in which any was really present.

The copper liquor should then be carefully chosen, and verified from time to time in this respect.

Suppose we take that named by M. Violette; it is good when well prepared, and for the rest the proportion of copper is the same as in the greater part of the copper liquors intended for this kind of analysis. Its proportions are such, that 10 cubic centimetres of the liquor correspond to 0 grm. ·05 centigrm. of uncrystallizable sugar, that is to say, are decomposed by this proportion of uncrystallizable sugar.

This copper liquor and a solution of sugar are needed to make a determination, which is conducted in the following manner:—

Weigh 5 grammes of sugar and dissolve it in such quantity of distilled water as to make 25 cubic centimetres of solution. Then place in a burette holding 25 c.c., and graduated to centimetres and tenths of centimetres. It is always needful to have ready a saturated solution of yellow prussiate of potash, acidified by acetic acid, so that it will require at least three parts of the blue copper liquor to neutralize the acidity of one part of this solution.

When all is prepared, take with a small pipette one cubic centimetre of copper solution (in order that this volume may be exactly measured, it is needful to use so small a pipette that 1 c.c. shall occupy a length of at least 5 or 6 centimetres (2 inches) in the tube), which place in a small white porcelain capsule 7 or 8 centimetres (about 3 inches) in diameter, then add sufficient water —say 10 or 12 c.c.—to fill up the capsule as high as the flame of the lamp extends. It should be placed on a circle of wire which will permit the flame to play freely on the bottom of the capsule.

Being made to boil, and care being taken, as is said above, to note if the liquid undergoes any change; when it is boiling the solution of the sugar to be assayed is dropped into the capsule a little at a time, from the burette in which is has been placed; if after the first few cubic centimetres have been dropped into the capsule and allowed to boil, the liquid which has taken a slight green tint (if the sugar solution was yellow), does not appear to have changed much; 8 or 10 more cubic centimetres are dropped in, the contents boiled up a few seconds and the lamp removed; the capsule is then allowed to rest to see whether the liquid is yet blue or green; if the colour is still strongly marked drop more sugar solution in, if weak, take from the surface, *i.e.*, from the clear liquid, a drop or two with a small glass rod, and put it on a plate of uncoloured glass placed on a sheet of white paper, then with another small glass rod take a little of the liquid prussiate, and mix it with the drop of that from the capsule. If the determination is far from finished, a plainly seen rose colour is the result; a precipitate of prussiate of copper is formed, which proves that there still remains in the capsule copper not separated. If the precipitate is very feeble or scarcely apparent, it shows that the assay is nearly complete.

The contents of the capsule are again boiled, and according to the result of the above trial less or more of the sugar solution is added and allowed to boil, and then subjected to another trial with the prussiate.

The determination is complete, that is to say, all the copper is precipitated by the uncrystallizable which was in the raw sugar, when the clear liquid (from the capsule) decanted into a glass tube no longer appears of either a blue or green tint, but of a slight yellow colour, and especially if no rose colour is formed when it is mixed with the prussiate. (If it is allowed to remain till cool the oxide of copper will become re-dissolved.)

Suppose that it has taken the whole of the contents of the burette—25 c.c.—to effect this result, it has then required all the uncrystallizable contained in 5 grm. of raw sugar to decompose 1 c.c. of copper solution. Now this liquor is of such a standard that 10 c.c. correspond to 0·05 grm. of uncrystallizable; 1 c.c. then corresponds to 0·005 grm.; there is then 0·005 grm. of uncrystallizable in the raw sugar assayed, *i.e.*, one-thousandth part, or 0·1 per cent.

If only 15 c.c. were needed instead of 25 for example, the following proportion expresses it:—

$$15 : 25 :: 0{\cdot}1 : x = \frac{2{\cdot}5}{15} = 0{\cdot}16 \text{ per cent.}$$

If on the contrary the burette has not held sufficient, and if a second burette of 25 c.c. be needed to finish the assay, the sugar only contains one-half of 0·1 per cent., or 0·05 per cent. of uncrystallizable. If, however, even with this quantity no rose-coloured deposit is observed at the bottom of the capsule after being allowed to settle an instant, and if the clear liquid from the capsule produces with the prussiate of potash as abundant a precipitate as 1 c.c. of copper solution mixed with a quantity of water, or better still, with a solution of the same sugar as that in the capsule but not boiled, it proves that the sugar analyzed does not contain any uncrystallizable.

When the amount of uncrystallizable in raw sugars or molasses is assayed, the yellow colour of the solution is an objection to the usual analysis, and besides, there is produced a kind of defecation proceeding from certain matters contained in the molasses or in the raw sugars being precipitated by the potash, which is found in excess in the blue copper solution. It is for this reason that we have adopted the process we have described, and by reason of which there is no need to rely exclusively on the colour of the liquid to ascertain the exact moment when the copper has been precipitated by the uncrystallizable sugar; as we have said above, the appreciation by colour, to determine the limit and the end of the experiment indicated in books on chemistry, has only been employed in view of the analysis of clear liquids containing considerable quantities of uncrystallizable, and not in view of liquids containing very little uncrystallizable and much other matter.

Some authors, in order to get rid of these foreign matters and to decolour the solution to be assayed, have prescribed a defecation by sub-acetate of lead, as for polariscopical determination, care being taken to remove the excess of sub-acetate of lead remaining in the clarified liquid by means of a solution of sulphate of soda. An insoluble sulphate of lead is thus formed, which is precipitated, and after filtration a perfectly clear and nearly uncoloured liquid is left. This method should not be employed, because as we have demonstrated, the sub-acetate of lead exercises an action on uncrystallizable sugar even in the cold. Though this action is not instantaneous, needing for example four or five days for a solution of pure uncrystallizable sugar mixed with an equal volume of sub-acetate of lead to lose, according to determination by the copper test, one-third of the quantity of the sugar it contained, yet it does take place; and as in the circumstances with which we are now engaged we operate on matters containing very little uncrystallizable, it is exposed to the chance of being completely or in great part destroyed, and its determination in these conditions will be of no use whatever.

Lastly, we believe that it is as well to add, that it will be quite illusory to endeavour to determine the uncrystallizable by means of what has been called the process of inversion, with the polariscope.

(*To be continued.*)

THE TAX ON SUGAR.

Reply to a Pamphlet dedicated to the Cobden Club, by John Benjamin Smith, Esq., M.P.

BY JOHN NEILL, JUN., M.A.

A pamphlet has recently been published by Messrs. Unwin Brothers, London, on "Free Trade in Sugar," bearing on the title page the name of John Benjamin Smith, Esq., M.P. The dedication to the Cobden Club which prefaces the pamphlet, declares that the system of classified sugar duties is an outrage on the great principles of Free Trade which the Cobden Club was instituted to uphold and keep alive, and Mr. J. B. Smith claims the duty of exposing "THE IMPOSTURE."

From such a startling preface one naturally expects to find something fresh and convincing in the pamphlet; but the arguments turn out to be simply a repetition of the old fallacies propounded by a London firm of wholesale grocers in their weekly organ, the *Produce Markets Review*, and exploded over and over again. Indeed, to those familiar with the sentiments and phraseology of that *Review*, it almost looks as if the pamphlet had been at least revised by the editor of that paper.

One circumstance which makes it look as if Mr. J. B. Smith were not the sole author, is the fact that on two occasions where there is necessity for bringing in his name he is mentioned in the *third person*, and not in the *first*, in which he would naturally mention himself when he required to allude to returns moved for by himself. These instances are to be found on pages 12 and 16 of the pamphlet.

On the title page three sentences are quoted from Mr. Gladstone and Mr. Cardwell, which, being placed in that prominent position, are probably intended to convey the gist of the pamphleteer's argument in a condensed form. These are as follows:—

> "The claims of the consumers are paramount; they have the right to buy their paper (sugar) in the cheapest markets."—Gladstone.
>
> "No courage or ability can induce the Legislature to sanction a system of protection."—Gladstone.
>
> "To strike with a superior duty one pound of sugar which, by a better mode of manufacture, contains more saccharine matter than another pound obtained from the same raw material, is to inflict direct discouragement on improvement."—Cardwell.

Now, whatever these sentences mean, it is quite certain that their authors are not advocates of a uniform duty on sugar.

The sentences from Mr. Gladstone are exactly the sentiments of those who wish to maintain the scale. For by the adoption of a uniform duty a protection would be afforded to the producers of the finer classes of raw sugar, and the consumers would suffer from the restriction of their supply of raw from the shutting out of the lower kinds. That Mr. Gladstone is in favour of a scale of duties may be gathered from the whole of his action on the subject, and his views will be found fully stated in a speech in in the House of Commons, on 7th April, 1864, from which the following are quotations:—

> "I am not able to deny that a classified duty has been the growth of experience. When the sugar market of this country was the monopoly of the colonial producer we had a system of uniform duty. That system of uniform duty was gradually modified and departed from in proportion as our market was opened to all the sugars of the world, and as we found we had to deal with a multitude of varieties of classes of sugar of which previously little or nothing had been known."
>
> "Is it true that uniformity is the general characteristic of our tariff? That tariff, I am happy to say, now reaches such moderate dimensions that it is not easy to produce instances of the soundness or unsoundness of the view taken on one side or the other on this point. The

> instances, however few, are nevertheless almost all in favour of classification."
>
> "I received the other day an address from Manchester, to which was attached a name distinguished in the annals of free trade—that of Mr. Ashworth—and which, I think, contains sound doctrine on this question, It says:—'Your memorialists are most desirous that the duties on sugar should be fixed at as low a rate as possible, and that in the interests of the consumer no impediments should be imposed to the importation of any class of sugar, from the very lowest quality to the finest loaf sugar; and in order that no one class of persons should be protected at the expense of another, it is, in the opinion of your memorialists, needful that the duties be assessed upon the article in proportion to the amount of crystallisable saccharine matter which it contains.' I believe that is a sound principle."

The sentence quoted from Mr. Cardwell might be supposed to aim at equalising the duties, on the ground that the scale inflicts a direct discouragement on improvement; but it only does so to this extent that it deprives "improvement" of the premium or bounty which a uniform duty would give, and the sentence might equally well stand thus:—To strike with an equal duty one pound of sugar which contains less saccharine matter than another pound produced by a better mode of manufacture is to afford a direct bounty to improvement.

The duty of the legislature is neither to encourage the production of one particular class or another, but is very plainly laid down in the resolution of the House of Commons' Committee, presided over by Mr. Cardwell, to the following effect:—

> "That the duties ought to be so regulated as to encourage the largest possible supplies of sugar from the various sources of production, in whatever form the same may be imported, whether as refined sugar or in combination with other substances to be afterwards separated by the process of refining."

That Mr. Cardwell has no sympathy with the advocates of a uniform duty is very evident from two of the resolutions which he proposed, and which were adopted by the same committee, viz.:—

> "That the amount of revenue now derived from sugar could not, with justice to the consumers of the lower classes of sugar, be raised by any uniform duty applicable to all classes."

> "That it is necessary to maintain the principle of a scale of duties, with standards designed to include several classes of sugar within each range of duty."

Mr. Cardwell also proposed the following resolution:—

> "That if any alteration be made in the present scale, the chief object of such alteration should be to admit, at a lower duty than at present, certain of the sugars now paying 12s. 8d. and 16s. respectively; or sugars which are now excluded, because, if imported they would be liable to those duties."

This was not adopted, Mr. Cave's resolution being carried in opposition. This latter, however, expressed the same thing in slightly different words as follows:—

> "That the existing scale may be rendered more equitable by such an alteration as shall admit, at lower relative rates of duty, the inferior portion of the sugars which are now liable to pay 12s. 8d. and 16s. respectively."

So much for the authority of Mr. Gladstone and Mr. Cardwell, who should certainly be the last to be quoted by Mr. J. B. Smith as favourable to his views, and those of the *Produce Markets Review*.

Mr. Smith appeals to the Cobden Club. What did Mr. Cobden himself say on the subject? It was this:—

> "If the present rate or anything like it be retained, then I think, in justice to the consumer, there ought to be *ad valorem* duties, (which I am by no means convinced is impracticable,) or a discriminating scale similar to what now exists."

If the members of the Cobden Club hold the same opinions as the great Free Trader, whose name it bears, the sentiments of the *Produce Markets Review* will meet with little sympathy from them even when presented to them by "the first chairman of the Anti-Corn-Law League."

To one or two of the statements in Mr. Smith's pamphlet we will now shortly call attention.

On pages 8 and 9, a case is given which is supposed to exemplify the hardships of the scale towards "the poor planter" as follows:—

> "The case stands thus:—A sugar planter having made 100 hogsheads of brown sugar, sells 50 hogsheads for exportation to a pieces-maker, who, on its arrival in England (previous to April, 1870), after the payment on it of a duty of 8s. per cwt., proceeds to re-make it into

> white sugar. The other 50 hogsheads, the planter exported to England on his own account; but previously to doing so, he took it into his head to perform the same process upon it, which the pieces-maker performed on the 50 hogsheads he purchased, viz., to make it into white sugar. But the unfortunate planter is astonished to find, on its arrival in England, that, instead of a duty of 8s. per cwt. paid by the pieces-maker, he is called upon to pay a duty of 11s. 3d. per cwt. On inquiring why he is made to pay 40 per cent. more duty on his sugar than was paid by the pieces-maker, he is informed that, instead of converting his brown into white sugar in the colony, he should have done it in England, and the extra duty he has been charged, is the penalty he has incurred for attempting to take the bread out of the mouths of the pieces-makers.
>
> "In vain the poor planter protests against this injustice; urging that he has to sell his sugar in the same market as the pieces-maker, and that, although he has paid 3s. 3d. per cwt. more duty, he can only obtain a similar price for his white sugar with the pieces-maker; and then he learns that, although a British subject, he does not enjoy the privilege of residing in England, where the 40 per cent. additional duty charged on his sugar is levied for the purpose of protecting native industry."

Now, although the principle is the very same, and there was no more injustice done to the planter or any one else when the duties were double in amount than at the present moment, the relative proportions of duty on the various classes remaining the same, yet the object of the writer of the pamphlet in selecting the old scale in force previous to April, 1870, for his illustration is obvious, inasmuch as it doubles the *apparent* injury. We shall, however, in criticising the case adhere to the old scale.

In a foot note the pamphleteer anticipates the explanation of the case, viz., that the refiner here has to pay duty on the brown sugar wasted; he denies that there is any waste, indeed hints that there is an increase in weight rather than a loss, and quotes a sentence from a Mr. Kohn to the effect that "what the pieces-maker does is to separate sugar into its component parts without altering them."

Possibly Mr. Kohn and Mr. J. B. Smith may possess the secret of how to turn fourth-class sugar into first-class without waste;

but as yet, it has not been discovered by anybody else. With such a power it is a wonder that they have not ere this started a refinery themselves, for they would soon make a fortune, or if they are independent of money-making, they could at least benefit the public by giving better sugar at a low price.

The results of the Cologne experiments (on which, by Mr. Smith's own showing, no expense was spared, and which, consequently, have some title to be considered accurate, since accuracy and not profit was the object aimed at in these experiments by impartial investigators) certainly did not lead to the conclusion that a worse can be made a better sugar without waste.

The case instanced stands really thus. The sugar planter having made 100 tons, sells 50 to a refiner. He pays duty at the rate of 8s. per cwt. = £400, and then refines it: if he makes it all into sugar which would be entitled to the 11s. 3d. drawback, he will find on weighing it up, on the basis of the Cologne experiments,* that he only has 35·6 tons, and on exporting this, if he does so, he receives back at the rate of 11s. 3d. per cwt., or in all, just the £400 he originally paid. The Customs make neither profit nor loss by the transaction, except a gain of the interest on the money paid for duty during the time the process of refining is going on, which even is a loss to the refiner he is not put to in other countries where a system of refining under bond exists.

If "the poor planter" converted his remaining 50 tons into first-class sugar, and sent them to this country in the refined state, he would only have 35·6 tons to send, and would be charged 11s. 3d. duty per cwt. "On inquiring why he is made to pay 40 per cent. more duty on his sugar than was paid by the pieces-maker, he is informed that"—he is *not* so charged; that his product enters the market taxed with exactly the same amount of duty as the refiner's product; that what the British refiner paid was £400 on a mixture out of which he was able to produce a quantity of sugar only equal to what the planter is charged the same £400 duty upon; that when he asks to have his refined product admitted at the same rate per cwt. as the other's raw, he is simply asking the Customs to present him with a bounty of £115 on the transaction; that although both are called "sugar," the thing the British refiner got was really a compound of sugar and foreign matters so impure as to be positively unfit for human food; that for the actual saccharine in each import, the one has been charged exactly the same as the other, namely, at the rate of 12s. per cwt. for pure dry saccharine.

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* It is usual for the uniform duty advocates to deny the accuracy of the Cologne experiments. Bmt mere denial, even if ever so often reiterated, is not disproof; and they must, therefore, be taken as the correct basis for all argument on the question until they are modified, if necessary, by a new set of experiments, equally impartial and trustworthy.

The sentence quoted from Mr. Kohn about separating the "sugar" into its component parts so far is applicable. What the process of refining has done has been to separate the edible saccharine in the brown sugar from the impurities which co-existed with it in the mixture as imported. It is the edible saccharine upon which the tax is intended to be imposed, and therefore the scale of duties is necessary, so that the tax upon the edible saccharine extractable from different qualities of raw sugar may be equalised.

Another statement made in the pamphlet, and founded upon a return moved for by Mr. Smith, ought to be noticed. It is found in page 13, and runs as follows:—

> "These returns show, that the loss to the Revenue, by levying classified rates of sugar duties, instead of an uniform rate of duty, in the years 1868 and 1869, on the supposition that the present duties had then prevailed, is stated at £77,302 for 1868, and £145,885 for 1869. As, however, the rates of duty during those years were double what they are now, the real loss was therefore double, being for 1868 £154,604, and for 1869 £291,770; total, £446,374. So that the pieces-makers were allowed, by means of the bounty granted to them by classified duties, to rob the Exchequer in those two years of the enormous sum of £446,374, in addition to the costly expenditure of collecting the duties by this system."

The statement here made amounts to this—That in the years 1868-1869 the scale rate yielded £446,374 less than an "uniform rate." Than what uniform rate? The answer is—than a supposed uniform rate of one penny per lb. All that is proved, therefore, is that in these years the public were taxed on their sugar nearly half-a-million less than if there had been 1d. per lb. charged!

It is too absurd to suppose that any argument for or against a scale can be drawn from the comparative yields of a scale and an arbitrarily fixed uniform rate. It evidently depends entirely upon what the rate of the uniform duty is fixed at—whether it will yield more or less than any other existing system. The assertion of Mr. Smith—That this £546,374 less collected than would have been had the duty been increased to an average uniform duty of 1d. per lb. on everything imported under the name of sugar is a robbery of the Exchequer by the piece-makers—is only worthy of being laughed at, and proves how an erroneous opinion once formed is apt to distort facts so as to square them with that opinion.

In the next paragraph of the pamphlet we were struck with a similarity to something we had read before, and on referring to a pamphlet entitled "The Sugar Question," which appeared about a year ago, we found the passage almost word for word as follows:—

From "The Sugar Question." Page 18.	*From Mr. Smith's Pamphlet.* Page 13.
The pieces-makers, who call themselves refiners, though, in reality, they are sugar spoilers, as their product lacks sweetness and flavour, and will not keep, have never been necessary, and are simply the creation of the scale of duties.	One is struck with astonishment that it has been possible for a small body (numbering only about 100), calling themselves sugar refiners, but more properly sugar spoilers, for whom there is no necessity, and who are the creatures of a classified scale of duties. . . . .
Such rubbish do they turn out in some cases, that it has to be scented and flavoured with Bergamot Vanille Lemon Oil, and other substances before it can pass into consumption.	Such rubbish do the pieces-makers turn out in some cases, that it has to be scented with Vanille Lemon Oil and other substances before it can pass into consumption.
At the best, pieces are simply decolorised brown sugar, more or less injured by the processes necessary to effect the change.	At the best, pieces are simply decolorised brown sugar, more or less injured by the process to which it is subjected to effect the change.

This accusation of flavouring pieces with Bergamot and other substances was made in the *Produce Markets Review* some time ago, and was contradicted therein by Mr. Forster, of Manchester. We too give it here an absolute denial. We deny also that the pieces-makers are the creatures of the scale. They are the creation of a demand from the public to be supplied with a pure, clean, wholesome sugar at a moderate price; of a determination on the part of the consumers to use sugar freed from the impurities, animal, vegetable, and mineral, with which raw sugars abound; of a want felt for refined sugar in a form different from loaves, which, although perhaps the best suited for the manufacturers' purpose, are but ill adapted for general use.

We desire no protection. If any revenue is to be raised from sugar, all we desire is that it shall be levied equitably to all parties, which can only be done on the principle of a scale.

But it would suit us infinitely better to see a real Free Trade in sugar—that is, a total abolition of all duty. The use of sugar has become almost as necessary as that of corn or salt, and all the arguments which would tend to keep them untaxed should apply to rescue sugar from the grasp of the tax-gatherer.

If Mr. Smith would turn his attention as a legislator to getting this instalment of a "free breakfast table," we would gladly side with him. But so long as he continues to make himself the mouthpiece of those who desire a uniform duty (a very different thing, though he thinks it the same), we shall continue to oppose him in spite of all the fallacies on the subject which have ever issued from the press of Messrs. Unwin Brothers.

Crops in Barbadoes.—In the last fortnight the weather has been cooler and drier. Sugar making has not yet commenced, but only a few mills grinding canes, which have been cut to get plants. Field work has been confined to planting and preparations for planting, for which the weather has been favourable. Reaping must depend upon the weather we have next month. If we have rains it will be deferred till March, much to the advantage of the crop. If the dry season sets in, the most must be made of the canes such as they are, which cant be much, for generally they are low with more leaves than cane.—*West Indian.*

ON THE MANUFACTURE AND REFINING OF SUGAR.

[*The Cantor Lectures, delivered before the Society of Arts.*]

By C. Haughton Gill.

Lecture I.

The subject of sugar divides itself naturally into two branches—the preparation of the raw material, and the refining or rendering it fit for use. Taking these two branches of industry together, I find that the result is, that, in 1866, the total consumption amounted to something like three millions of tons, reckoning only that which came through European hands in some way or other, and of this amount nearly one million tons were manufactured in Europe from beet-root. No doubt some of you have heard that sugar made from beet-root is not so sweet as that ordinarily used in this country, which is made from the sugar-cane. This is quite a mistake. Sugar procured from the cane and from beet-root is exactly the same; and I wish to impress this upon you particularly at the outset, inasmuch as, in describing the operation of refining, I shall make no distinction between them, except in immaterial details. Sugar from either source is known as "cane-sugar."

I must next assign limits as to what I have to tell you. You must understand that I have nothing new to say upon this subject, but simply to explain to you what is known to every chemist who has studied the subject of the production and refining of sugar. I shall confine myself simply to telling you what is done in certain cases, and why it is done.

But, in order to explain the reason why such operations in the manufacture and refining of sugar are carried out in the form in which they are, I must first bring to your knowledge certain facts in chemistry and physics, and as I cannot advantageously unite these explanations with the descriptions of the processes themselves, I propose to occupy this first lecture on bringing before you some of these physical and chemical facts which I shall have afterwards to apply; and though this may appear a somewhat round-about way of attaining my object, I think it will really conduce to brevity and clearness.

First of all, I must state that the sugar which we obtain from the sugar-cane or beet-root exists already formed in those plants. It is not created by the process of manufacture, but exists in the plant, dissolved in water, in the shape of juice. But together with the sugar we find dissolved a variety of other bodies. I have in this bottle some of the pure juice of the sugar-beet which has been pressed out, and from the colour, which is nearly black, you will readily perceive that it is not a solution of pure sugar. It contains, among other bodies, a substance which approaches very nearly to the white of an egg, or albumen, and also some bodies like gums, the presence of which I can show you by adding to the liquid a solution of tannin, the astringent principle of oak-bark. By adding this, you will see in a few moments that these albuminous matters settle down in flocks, having formed insoluble compounds with the tannin; or I can show their presence more readily by using another reagent called "basic acetate of lead," which precipitates most of these albuminous and gummy substances as insoluble lead compounds. This basic acetate of lead has now produced a thick greenish precipitate in the beet-juice, and on filtering the mass you see that a clear, colourless liquid comes through, which you must understand contains the sugar of the original juice. Cane-juice contains the same, or similar impurities as beet-juice, though in much smaller proportions. The object of the sugar-makers is to remove, at the first operation, as many of these impurities as possible, so as to make his juice approximate as nearly as may be to a solution of pure sugar; but preliminary to the treatment of the juice comes the question of winning it, or getting it out of the plant. The most obvious way of doing that is to crush or rasp up the plant, thereby destroying the little cells in which this solution of sugar and other bodies is contained, and this is the method which is most commonly employed. I will go more into detail with regard to the extraction of the juice, when I come to speak of the manufacture of beet-root sugar, which is that branch of the subject upon which I shall more specially enlarge; but I may here mention that there is another way of obtaining the juice, which, at any rate in principle, is preferable, but to explain to you what this is, I must first give an illustration of an important physical fact.

I have in this glass a solution of a gummy body, called dextrine, which is perfectly soluble in water, and a solution of which will readily filter through porous paper. I will mix with this a solution of bichromate of potash, which is a coloured salt, and having mixed the two together, I will now fill a small sac, which is part of the gut of the rabbit or some small animal, with some of this yellow solution. The sac is what is called watertight, and I will now suspend it in a vessel filled with pure water. In process of time we shall see the solution of this orange-coloured crystalline salt, the bichromate of potash, find its way out through the walls of the little watertight sac, whilst the gummy body itself will not pass through the membrane. Whilst that is proceeding, I will start a similar experiment on a somewhat larger scale. Over the mouth of this glass vessel I have a piece of parchment paper, which is quite watertight in the ordinary sense, but still it will allow this curious passage of some soluble bodies to take place through it, although it prevents the passage of others. I will put some of this mixture of dextrine and bichromate of potash into the vessel, and then placing it in a dish of water, we have the two separated simply by that piece of parchment paper, and we shall see that the bichromate of potash will pass through, whilst the dextrine will not. To show you how we can demonstrate the truth of this, I must now show you the reaction of the dextrine and of the bichromate of potash. First, I will put a little of the dextrine into water, and add to it a solution of iodine. You perceive that the liquid immediately turns a dark purple colour. By this means, therefore, I can detect the presence of dextrine if it passes through into the water. The bichromate of potash has a very remarkable power of colouring water, and accordingly, even a small quantity of it would be manifested by the liquid turning yellow; but as that is not very visible in this light, I will add to it a solution of acetate of lead, which will form in the liquor a precipitate, the chromate of lead rendering it opaque and yellow. This difference between the two bodies with regard to their passing through moist watertight membranes, is one which is observed between two great series. On the one side we have those bodies which, when dissolved in water, will pass through most membranes, animal or vegetable, when there is water on each side; and we have again other bodies which, like the dextrine, do not possess that power. Those which can pass through are, for the most part, capable of assuming a crystalline condition, and the whole class, therefore, has been designated crystalloid. The others more or less resemble glue in character, and are called colloids. The constituents of cane and beet-juice are partly colloid and partly crystalloid. The solution of them is contained in little cells, which you may compare to the cells of an orange, the walls of which are capable of acting in the same way as this piece of membrane or this parchment paper, causing the separation of the two constituents of the cells, when slices of the plant are immersed in water, the crystalloid constituent passing outwards by this process of diffusion, as it is called, and the colloids remaining behind. If, then, we cut up a sugar-cane or beet-root into slices of a convenient size, and immerse them in water, the sugar, which is a crystalloid, and the saline particles of the juice, pass out into the water beyond, while the gummy bodies, to a great extent, remain behind; whereas when we rasp up the plant and squeeze out the juice, we get in it the whole constituents, colloid and crystalloid together. Theoretically, therefore, the diffusion process is preferable to the other. It is attended with some practical difficulties, which, however, have been got over very successfully in India, with regard to cane-juice, and which I have seen worked successfully with regard to the beet-root, though people are not quite agreed about it.

I will now come to the subject of the solution of bodies. Everyone knows, more or less, what is meant by solution, but there are some limitations to the process which are always understood, If we take a body which is soluble in water, you know it disappears like sugar or salt when stirred up with water. Here is some of the yellow salt which I used just now, and dissolving some in water, you see that the liquid is immediately coloured, and it will go on increasing in colour up to a certain point, but the water will not dissolve more than a certain amount at this temperature. In this bottle there is some of the same salt which had been shaken up in the bottle for some days; the liquid is saturated with salt at this temperature, but though saturated at this temperature, it would not be so at another. For instance, if I put some of this saturated solution of bichromate of potash into a test-tube, and add some more of the solid salt and warm it, we shall find that when the liquid is heated, the power of solution of the water increases, and the solid salt disappears. I may, possibly, have added too much, because hot water has limited powers of solution as well as cold, and if we continued adding the salt to the hot liquid from time to time, we should at length arrive at a point when no more could be taken up, and then the liquid would be saturated at a high temperature. But if, instead of heating this up to the boiling-point, I had stopped short of that, and only saturated it at a temperature half-way between the boiling-point and the ordinary temperature of the room, I should have dissolved more of the salt than at the lower temperature, but less than at the higher. You must understand, therefore, that it is not because a liquid is what is called warm that it will dissolve as much of a given body as it will when it is boiling hot. As a rule, that is not the case, especially in the case of sugar. The large quantity of salt which I added here is now entirely dissolved, but on cooling the liquid again you will see, of course, that that portion of the salt which has become dissolved in virtue of the heat will again be deposited, leaving above it a cold saturated solution. It is important to recollect that this is the case, because on this fact depends the final extraction of sugar from its solutions. When the particles of salt, separated in this way from the hot saturated solution have time to arrange themselves in any way which the forces acting upon them may direct, they generally do so in very definite forms, and produce what are called crystals. On the table are two or three examples of crystals which have been formed in this way, by the slow cooling or evaporation of a liquid containing them in solution; the crystals are regular and of large size. But when the crystallization produced is rapid—when it deposits more quickly—then we find that the deposit takes the form of small irregular crystals or grains. There is another way of obtaining a saturated solution of a soluble body besides this one of dissolving it in a hot liquid, and then cooling it, which is this. If you take a weak solution of a body and take the water out of it, you will obviously arrive at some point at which the body itself will remain relatively in excess. For instance, if I take a solution of common salt, and put it into a basin, and boil away the water, you will find that the salt will gradually crystallize out. Thus we arrive at the same result. We will now examine the result of our experiment on diffusion. I do not know whether it is very visible in the room, but to me it is perfectly clear that the water in the little jar in which the sac was placed is coloured yellow, especially at the bottom; and on examining the dish of water in which the vessel with the parchment paper was placed, I think we shall find the same result. I will divide the water which was outside the dialyser, as it is called, into parts. To one I will add a solution of iodine, and although I have added a larger quantity than I did before, you see there is no perceptible increase of colour. If, however, I add some acetate of lead, which I will do to the other portion, the precipitation shows at once that a considerable portion of "bichromate" has passed outwards. This is merely to show you, by a rough method, what takes place when the juices of plants are subjected to diffusion. Now, taking the liquid within the dialyser, we find that the iodine solution at once acts as vigorously as before upon the dextrine.

I have treated this subject very shortly, but I hope you understand distinctly the point which I wish to impress upon you about the solubility of bodies in cold and hot liquids, that there is a limit to each case, and that between a cold liquid and the hottest which you can make, for every temperature there will also be a special limit to the power of solution. I am speaking in general language, because every chemist present knows that there are exceptions to this rule, and some few bodies are more soluble in cold liquids than in hot; but still the great majority of bodies behave in the same way as sugar, and sugar is far more soluble in hot water than in cold, and for every temperature between the boiling and freezing points of water there is a specified limit of solubility. I have shown you that when a hot saturated solution is cooled, it deposits the salt which was dissolved in it by virtue of the high temperature, but when hot saturated liquids are cooled slowly and carefully, they pass through the limit of saturation in a most curious manner. I have here a flask filled with a perfectly transparent and very strong solution of a salt called sulphate of soda. It is quite cold, having been heated at about 12 o'clock, and it has been standing for some hours in cold water. Still there are no crystals formed, although there is a great deal more salt dissolved in the water than could have been dissolved if I had merely shaken it up with the salt—that is, at present the liquid is what is called supersaturated, and this state of supersaturation will continue until the liquid becomes disturbed in a peculiar way. Some liquids require to be disturbed in one way, and some in another, before this state of supersaturation is destroyed. It may suffice in this case to simply admit the air by withdrawing the cork. As I do so, probably a small particle of dust falls in, and you see, extending from the upper part downwards, an extremely rapidly crystallization. So it will continue until the whole mass appears solid, the flask being in reality filled with large numbers of very minute crystals. At the same time, the temperature is somewhat risen, but we need not go into that. But what I wish you to understand from this experiment is that a liquid of a given temperature may at a given moment hold in solution more of a solid than it ought to, and in that case we call it supersaturated. We know nothing, I believe, at present why it is so, at least in many cases; in this particular case I believe it has been fairly explained. I will illustrate the same point in another case, in order to show you that, in some cases, we must disturb the liquid in a particular way if we wish to obtain this sudden crystallization. Here I have a solution of another salt, which has been dissolved for some days. It is one which will admit of considerable rough treatment in the way of shaking without crystallization; but if I open the jar and drop in a very small crystal of the same salt which is here dissolved, in a few minutes the whole liquid will become solid from the formation of crystals of dissolved material. This shows you that it is more difficult to disturb the equilibrium of some liquids than others, and that you must seek special means for disturbing them in the right manner. If you dissolve in a liquid, sugar or any other body which is somewhat impure, which contains an admixture of foreign bodies, and then obtain crystallization either by cooling a strong hot solution, or by evaporating off some of the water, you will attain a very considerable purification of that substance. In the process of crystallization, the particles of the body come together and form a solid, leaving in solution those bodies which are present in quantities too small to crystallize out of the quantity of water still present and those which cannot crystallize at all. The crystals, when freed from their mother-liquid, must necessarily be considerably purer than the original material. This is an important point because the purification of the crude sugar of commerce and rendering it into that beautiful white state in which we see it depends in a great measure on the power of crystallization to separate impurities.

Having thus treated, as far as I am able at the present time, the subject of crystallization, both in the ordinary case and from supersaturated solutions, I must proceed to describe what we understand by the term boiling, and to show under what conditions liquids can be boiled, and how the temperature at which they boil will vary under certain circumstances. You have all seen water boiling, and you know that when water is contained in a vessel, and heat applied to the bottom, large bubbles, not of air but of steam, are formed there, and rise through the liquor, creating quite a commotion, which we term boiling. Let us go back from that for a moment to the evaporation of a drop of water. If you spill a drop of water, you know that in a short time it dries up and disappears—it passes away into the air. This, of course, arises from the particles of the water gradually rising from the surface of the liquid into the air, and in so rising they had to overcome the pressure of the air on the surface of the liquid. You know that air presses with a force of about 15lbs. per square inch, and that force tends to keep the particles down—to press them back into the water again. If that is the case, we should naturally suppose that if we could remove the atmosphere, the particles would rise more freely, and that is so. If we put a drop of water under the vacuum of the air-pump, it dries up very quickly indeed, there being nothing to keep it back. But what do we do when we apply heat to a liquid in a vessel? You know that you can dry wet, moist writing, or any other liquid, before the fire more quickly than if you simply expose it to the air at ordinary temperatures. This must be because the heat causes the particles of water to rise more quickly and readily, that is, it gives them a greater force to overcome the pressure of the atmosphere. If you put water into a tube and heat the bottom, you give the particles a tendency to separate and fly apart from one another, and at a certain temperature they succeed in flying apart and form what is really a true gas, water, vapour or steam, which, being lighter than the surrounding water, rises through it and disappears. Is it not plain, then, that if the pressure on the water is rendered less, we shall not have to heat the water so much to give this vapour an elastic force or tension sufficient to overcome the pressure? The lower the pressure to which the water is subjected, the less is the temperature to which we shall require to raise it in order to make its vapour overcome the remaining atmospheric pressure on it. I can illustrate that by experiment. I have here a flask which is connected by a flexible tube with the receiver of an air-pump, so that when the air-pump is set working, it will draw more or less of the air out of the flask, and, accordingly, I shall be able to put warm—not boiling—water into the flask, and submit it to a less pressure than that of the atmosphere. Before doing so, I must first put a few little bits of some metal into the flask, or else the water will boil very irregularly. Water boils in metals regularly, but in glass very irregularly and with great commotion; but by putting in a few fragments of metal you overcome this difficulty. This water which I put in the flask is hot, but still it is much below the boiling point. Upon working the air-pump a few moments, as the atmosphere is withdrawn, the force which the vapour will have to overcome will become less and less, and presently the pressure will fall so low that the vapour of this merely warm water will be able to come away out of the liquid as freely as it could if I had been applying a powerful heat to the bottom of the vessel, and thereby increasing the tension of the vapour. This boiling of water under these conditions is a thing which everybody is acquainted with, but still it is one which I am bound to bring before you at this time, because it is the principle of the vacuum pan which I shall have to speak of hereafter.

(To be continued.)

BOILING TO GRAIN.

By M. A. Code.

(From the French).

In the first place, I will say a few words on the apparatus. It is formed of a steam boiler, surmounted with a dome, into which is fixed the tube of an air-pump. Three coils, one above another, each having separate means of supply with steam, and for the return of the condensed water, allow of the heating of the syrup so far and in proportion to its level in the pan.

There are two steam-guages, one to indicate the pressure of the steam as it comes from the boiler, a second to show the pressure in the apparatus itself; the first is called the boiler guage, the second the vacuum guage. Successive charges are introduced into the pan by a tap. Four lunettes cased in bronze allow of the liquor being seen boiling in the pan. Lastly, a plunger, made to slip easily into a long narrow barrel, draws from thence, when pulled out, a sample of the *masse cuite.*

Having described the apparatus, I will divide the operation into four distinct parts—1st. Concentration of the syrup; 2nd. Formation of the crystals; 3rd. Increasing the size of the crystals; 4th. Formation of the largest quantity possible of crystals.

I.—Concentration of the Syrup.

After having formed a vacuum in the apparatus by means of the air-pump, the tap is opened, and, under the atmospheric pressure, the syrup immediately flows into the pan. The flow is generally stopped when the syrup has reached the level of the second eye-glass. Then the principal steam-tap is opened about one-fourth, and those of the two lower coils fully. Great care must be taken in order to avoid a rupture of the metal by sudden and unequal expansion. The syrup is not long in boiling, as the temperature at this point depends on the pressure on its surface. As the operation is carried on in a vacuum, the boiling point may be lowered from 110° to 60° Cent. (230° to 140° F.) The reduction of the temperature owing to this diminution of pressure renders the transformation of crystallizable sugar into glucose less easy, and allows of the shortening of the duration of boiling, from which a considerable increase in return of sugar has resulted.

In proportion as the syrup becomes concentrated, the index of the vacuum-guage will at first descend and then ascend; and at the end of about an hour it will have reached the No. 19 on the dial. The index of the boiler steam-guage will, after having marked two and three atmospheres, at this instant mark four atmospheres.

We may mention in passing that these steam-guage indications are of great importance, because they show the concentration of the syrup. Further, great attention, habit, and experience are needed for judging of the state of the syrup by a *proof*, and the indications named will serve as a means of control. In effect, the vacuum guage indicates the expansion of the steam disengaged from the syrup, the other the pressure of the steam from the boiler. Then if the steam tap is not altered, the expansion of the steam is due to the degree of concentration of the juice. If this is very thin it will absorb more steam, and consequently the steam-guage will not show a very high pressure; but in proportion as the liquid is concentrated, the condensation of the steam will diminish, and the steam-guage indications will increase.

This being admitted, after nearly an hour's boiling the principal steam tap which had only been opened one-fourth is now opened to its full extent. This sudden change of temperature will favour the formation of grain, which will commence in about ten minutes, when the vacuum steam-gauge will mark nearly 24, and the boiler steam-gauge five atmospheres.

II.—Formation of Grain.

It is needful to determine whether large or small grain is required. In the first case we must form the grain when the index of the vacuum gauge is at 19 and that of temperature shows 4 atmospheres, because the lighter the proof syrup is at the moment when the grain forms the fewer the number of crystals. Then these crystals being few it will be easy, as will be seen shortly, by conducting the boiling very slowly to obtain large bright crystals.

To form the grain, when the syrup has been boiled to light proof for the large, or heavy proof for small crystals, the first charge is made by adding the needful quantity of syrup, say 2 per cent. of the total quantity.

In practice I have observed that in order to obtain good results it is better to open the charge tap to the full extent at each charge, keeping it open only 10 to 15 seconds, and allowing an interval of 2 or 3 minutes to elapse between each charge. Nevertheless an intelligent boiler will vary the operation according to the quality of the syrup, so that it is difficult to give an invariable rule. For the rest after each addition of liquid the same point of concentration as was reached before, must be waited for before a fresh quantity of syrup is added. This must be continued until the grain begins to show, which will be to about the 5th or 6th charge.

The grain will appear in the form of fine powder which might be taken for minute bubbles of scum, a practised eye is however rarely deceived. There is no fear of crystallization not continuing to increase, it will go on spontaneously after further additions of juice or syrup carefully made; but it is however important never to wait till the proof become too heavy, because this accident will be prejudicial to the sugar and will modify its faculty of crystallization.

III.—Enlargement of the Grain.

When the addition of juice has been repeated nearly 20 times, the grain will have become large enough to be seen in the syrup which runs down the lunettes. Starting from this point, the boiling may be conducted at a lower pressure ; to this end the charges may be made seldomer, and with a larger quantity at once.

The feeding tap may without danger be left open for 25 seconds, and observing the indications of the steam gauges, endeavour to keep about 20 of vacuum expansion, and at 4 atmospheres of the boiler. Nevertheless in forming large grain, the vacuum gauge may be allowed to fall to 18; then the pan will be fed seldomer, care being taken to increase the length of each charge, the crystals will have in this way all the time needful for their formation. To obtain a fine grain it will on the contrary be needful to add the juice frequently, and by small quantities, in order to disturb the crystallization oftener, this principle is founded on the different characters of the two modes of crystallization.

This operation which appears so easy is however of great importance to the manufacturer. Without wishing to do so, without even knowing it, the workman may lose large sums for his employer. As a proof of this assertion, I will give a very striking example: I had at Cuincy three boilers, the first produced during the whole of last season 59 per cent. in weight of sugar of the first *jet;* the second 51 per cent., the third 45 per cent. It is easy to account for the difference in these results if we remember with what facility the crystals already formed may be re-dissolved by adding to the *masse* too large a quantity of liquid in one charge. The crystals thus melted will only be reformed with great difficulty and have a great tendency to change into uncrystallizable sugar.

To avoid these losses the boiler should examine the *masse* regularly and with great care. He should never confine himself to the two or three trials (by proof stick) which may be *quite* necessary.

The manager should be able occasionally to observe the movement of the indexes of the steam-gauges, which if the operation is well managed will rise or fall very slowly without ever taking those sudden starts which sufficiently denote the boiler's incapacity.

After two hours of feeding, the juice will, in an ordinary way, cover the coils, the steam may then be admitted into the third coil. It will now also be possible to feed continuously if it is wished, as the operation becomes easier, the crystallization being now vigorous and regular.

IV.—FORMATION OF THE GREATEST POSSIBLE AMOUNT OF GRAIN.

After another hour's feeding of the boiler, in all three hours, a higher temperature may be commenced and the index of the vacuum steam guage allowed to mount from 20° to 25°. The aim of this concentration is to form the largest possible quantity of grain; it will render the process of crystallization more active and more rapid, and the influence of greater heat will give the cystals more solidity and dryness. Most boilers, to obtain this result, shut off one-fourth of the supply of water to the air-pump. The vacuum of the apparatus being thus diminished, the boiling point of the liquid is raised.

After five or six hours the last proof should be taken, which ought to be rather strong. The sample taken should, if held between the index-finger and the thumb, fall back on to the latter very slowly in forming what the boilers call the tassel; this tassel is generally terminated by a thread of very clear syrup, called the string. In these conditions a fine hard sugar will be produced.

Having made this last trial, it will be well, should it be wished to obtain a very white sugar, to lower the temperature to 55° C. (131° F.), by fully opening the water supply of the vacuum apparatus and closing about one-fifth the principal steam supply tap.

ACCIDENTS TO THE BOILING.

In explaining the phenomenon of defecation, I showed that the soluble organic salts, the base of lime, which are deliquescent and very viscous, especially prevent the sugar from crystallizing.

It often happens in France, at the close of the manufacture, some of the frozen beet roots begin to thaw; the pectose in direct contact with the juice is transformed into metapectic acid; lactic acid is also formed. Then these acids, with the lime, will consequently, with the heavy syrups, form some viscous compounds, which may not be extracted before the time of boiling. In this case a process given by MM. Leplay and Cuisinier may be practised, which I have used at Cuincy. It consists in the employment of carbonate of soda after saturation, because the carbonic acid of the carbonate of soda will combine with the lime of the metapectate and lactate of lime, and insoluble carbonate of lime, and metapectate and lactate of soda are formed: some similar reactions will take place with aspartate, citrate, or malate of lime. The new salts formed are not more viscous, and are less preventive of crystallization.

Before having recourse to this means it will be well to try another which has been given by M. Leze, chemist, of Douai; it is simply to feed the vacuum pan for one hour with water only [instead of juice].

The difficult boilings may also proceed from from too large excess of lime, a certain means of ascertaining this is to use *curcuma* paper (this paper which is used in the whole of Germany and the north of France differs from litmus paper with which such feeble and inconstant colours are produced that it will not serve to test the juice). The *curcuma* paper on the contrary will become of a very deep colour: it will be sufficient (if this excess of lime is shown) to feed with some portion of syrup which has been submitted to a double filtration through char.

In conclusion I do not hesitate to protest against that deplorable practice which consists in the obtaining of large grain by only partially emptying the first boiling and re-commencing a second by feeding the crystals already formed. Those who thus act know however that a considerable part of the crystallized sugar is by this means changed into glucosic products.

COMMERCIAL & OTHER STATISTICS OF THE UNITED KINGDOM.

From Francis Reid & Co.'s Monthly Circular, January, 1872.

Year	Estimated Population, 31st Dec.	SUGAR. Raw & Refined		MOLASSES		TEA.		COFFEE.		COCOA.	
		Tons.	Lbs. per Head	Tons.	Lbs. per Head.	Lbs.	Per Head.	Lbs.	Per Head.	Lbs.	Per Head.
1845	27,875,000	242,834	19·51	..	..	44,193,433	1·59	34,293,190	1·23	2,579,497	0·09
1846	28,189,000	261,933	20·81	..	..	46,740,344	1·65	36,754,554	1·30	2,951,206	0·10
1847	28,093,000	290,282	23·14	..	..	46,314,821	1·65	37,441,373	1·33	3,079,198	0·11
1848	27,855,000	309,424	24·88	..	..	48,734,789	1·75	37,077,546	1·37	2,919,591	0·10
1849	27,632,000	299,041	24·24	31,853	2·58	50,021,576	1·81	34,399,374	1·24	3,206,746	0·12
1850	27,423,000	310,391	25·35	40,653	3·32	51,172,302	1·87	31,166,358	1·14	3,080,641	0·11
1851	27,529,000	328,581	26·74	45,915	3·73	53,949,059	1·96	32,504,545	1·18	2,978,344	0·11
1852	27,570,000	358,643	29·14	38,662	3·14	54,713,034	1·98	34,978,432	1·27	3,328,527	0·12
1853	27,663,000	374,379	30·32	39,997	3·24	58,834,087	2·13	36,983,122	1·34	3,997,198	0·14
1854	27,788,000	416,620	33·58	42,336	3·41	61,953·041	2·23	37,350,924	1·34	4,452,529	0·16
1855	27,899,000	384,267	30·86	46,126	3·45	63,429,286	2·27	35,764,564	1·28	4,383,023	0·16
1856	28,154,000	374,978	29·69	47,111	3·75	63,272,212	2·25	34,995,944	1·24	3,634,135	0·13
1857	28,359,000	382,294	30·20	30,556	2·41	69,130,482	2·44	34,367,484	1·21	2,656,233	0·09
1858	28,566,000	450,203	35·30	43,829	3·44	73,217,484	2·57	35,338,111	1·24	3,071,115	0·11
1859	28,774,000	457,449	35·61	34,890	2·72	76,362,008	2·65	34,492,947	1·20	3,480,987	0·12
1860	28,944,000	448,070	34·61	27,998	2·58	76,859,428	2·66	35,674,381	1·23	3,481,484	0·12
1861	29,196,000	478,040	36·06	54,500	4·18	77,949,465	2·67	35,375,675	1·21	3,576,384	0·12
1862	29,400,000	485,856	37·24	55,840	4·22	78,817,060	2·68	34,664,155	1·18	3,926,500	0·13
1863	29,600,000	495,050	37·46	37,452	2·83	85,206,776	2·88	32,986,116	1·11	4,106,468	0·14
1864	29,820,000	499,604	37·53	25,341	1·90	38,637,099	2·98	31,591,122	1·06	4,171,082	0·14
1865	30,000,000	545,781	40·75	28,692	2·14	97,921,944	3·26	30,748,349	1·02	4,286,635	0·14
1866	30,050,000	559,166	41·68	32,285	2·41	102,325,067	3·41	30,944,363	1·03	4,606,997	3·15
1867	30,200,000	593,358	44·01	20,186	1·50	111,057,705	3·68	31,567,760	1·05	4,585,517	0.15
1868	30,450,000	561,135	41·03	37,379	2·75	106,918,118	3·51	30,608,464	1·01	5,730,223	0·19
1869	30,750,000	583,369	42·17	37,088	2·70	111,889,118	3·64	29,109,113	0·94	6,564,216	0·21
1870	31,100,000	666,368	48·00	35,790	2·50	117,622,577	3·78	30,629,710	0·99	6,943,109	0·21
1871	31,500,000	702,201	49·93	34,181	2·43	123,529,544	3·92	31,010,725	0·98	7,329,747	0·23

COMMERCIAL AND OTHER STATISTICS OF THE UNITED KINGDOM.

Year.	RICE.		TOBACCO.		TALLOW.		WINE.		BRITISH & FOREIGN SPIRITS.	
	Tons.	Lbs. per Head.	Lbs.	Per Head.	Tons.	Lbs. per Head.	GALLONS.	Per Head.	GALLONS.	Per Head.
1845	13,466	1·08	26,162,159	0·94	59,595	4·79	6,736,131	0·24	26,665,501	0·91
1846	21,691	1·72	26,859,788	0·95	59,192	4·70	6,740,316	0·24	28,344,746	1·01
1847	55,166	4·40	26,638,136	0·95	53,465	4·26	6,053,847	0·22	25,534,820	0·91
1848	19,519	1·57	27,194,368	0·98	70,336	5·66	6,136,547	0·22	26,822,175	0·96
1849	25,474	2·06	27,553,238	1·00	70,624	5·72	6,251,862	0·23	28,216,149	1·02
1850	20,051	1·63	27,584,406	1·01	60,231	4·92	6,437,222	0·23	28,653,695	1·04
1851	19,173	1·56	27,915,024	1·01	54,049	4·40	6,279,759	0 23	28,742,691	1·04
1852	27,601	2·24	28,418,568	1·03	58,616	4·76	6,346,061	0·23	30,051,189	1·09
1853	38,917	3·15	29,564,695	1·07	66·848	5·41	6,813,830	0·24	30,151,075	1·09
1854	41,748	3·36	30,391,841	1·09	38,001	3·06	6,776,086	0·24	30,998,057	1·12
1855	48,345	3·88	30,332,657	1·09	39,714	3·19	6,296,439	0·23	26,731,609	0·92
1856	71,032	5·65	32,413,000	1·15	50,360	4·07	7,004,953	0·25	28,284,989	1·00
1857	74,523	5·85	32,680,369	1·15	53,586	4·20	6,605,710	0·23	28,864,186	1·02
1858	88,093	6·91	34,110,851	1·19	61,259	4·80	6,697,224	0,23	27,774,347	0·97
1859	65,334	5·09	34,791,261	1·21	51,825	4·03	7,262,965	0·25	28,790,364	1·00
1860	76,778	5·94	35,412,845	1·22	71,049	5·50	7,358,189	0·25	27,066,125	0·94
1861	79,172	6·07	34,976,453	1·20	57,596	4·42	10,787,091	0·37	25,097,640	0·86
1862	132,351	10·08	35,614,985	1·21	48,519	3·70	9,803,046	0·33	24,720,614	0·84
1863	73,225	5·54	37,616,246	1·27	56,333	1·26	10,478,057	0·35	24,718,991	0·84
1864	80,518	6·05	38,239,521	1·28	49,300	3·70	11,456,715	0·38	26,544,650	0·89
1865	27,264	2·04	39,179,801	1·36	66,015	4·93	12,061,386	0·40	26,990,464	0·90
1866	48,726	3·63	40,995,161	1·36	64,518	4·81	13,327,916	0·44	29,769,868	0·99
1867	78,868	5·85	41,053,612	1·36	52,076	3·86	13,754,343	0·45	29,090,697	0·96
1868	134,729	9·91	41,280,001	1·36	57,163	4·02	15,151,741	0·50	28,610,658	0·94
1869	175,038	12·75	41,719,500	1·36	59,056	4·30	14,840,158	0·48	29,624,124	0·96
1870	92,802	6·72	41,717,012	1·34	77,879	5·32	15,168,304	0·50	31,707,609	1·02
1871	103,649	8·37	42,656,658	1·35	67,630	4·81	16,341,446	0·52	31,895,883	1·01

Commercial and other Statistics of the United Kingdom.

Year	FOREIGN WOOL		COTTON		RAW SILK		TOTAL VALUE OF IMPORTATIONS.	
	Lbs.	Per Head	Lbs.	Per Head	Lbs.	Per Head	£	Per Head
1845	74,151,502	2·66	679,063,569	24·36	4,058,737	0·15	Value not ascertained prior to 1856.	
1846	62,243,482	2·31	401,925,570	14·23	4,190,054	0·15		
1847	57,782,873	2·23	399,753,295	14·23	3,697,187	0·13		
1848	64,289,263	2·54	639,000,369	22·94	4,181,027	0·15		
1849	64,318,150	2·33	656,575,476	23·76	4,518,132	0·16		
1850	59,938,104	2·19	561,107,165	20·46	4,385,097	0·10		
1851	69,581,988	2·53	645,399,389	23·44	4,059,449	0·15		
1852	32,444,525	2·99	817,898,144	29·67	5,129,231	0·19		
1853	107,671,080	3·89	746,709,069	27·00	6,046,852	0·22		
1854	81,612,732	2·94	764,007,037	27·49	6,439,104	0·23		
1855	69,846,980	2·50	767,383,792	27·51	4,433,307	0·16		
1856	89,531,599	3·18	877,225,440	31·10	5,945,074	0·21	172,544,154	123/2
1857	93,262,679	3·29	837,391,296	29·53	10,371,306	0·37	187,844,441	133/5
1858	100,037,181	3·50	884,732,576	30·97	3,963,057	0·14	164,583,832	116/0
1859	104,267,884	3·62	1,050,845,836	36·52	7,768,564	0·27	179,182,355	125/5
1860	117,633,210	4·06	1,140,510,112	39·40	6,024,654	0·21	210,530,873	147/0
1861	92,795,737	3·18	958,696,816	32·84	4,613,689	0·16	217,485,024	150/2
1862	123,840,673	4·21	309,258,656	10·52	5,089,407	0·17	225,716,976	154/7
1863	113,449,703	3·83	428,230,768	14·47	5,368,226	0·18	248,919,020	169/5
1864	150,539,306	5·05	648,602,416	21·75	1,733,271	0·06	274,952,172	186/0
1865	129,761,317	4·33	675,069,360	22·75	4,586,260	0·15	271,072,285	182/2
1866	172,785,201	5·75	988,177,568	32·88	3,488,711	0·12	295,290,274	197/2
1867	142,951,240	4·73	911,910,496	30·17	3,947,634	0·13	275,183,137	182/6
1868	147,673,844	4·85	1,005,463,536	33·02	4,105,882	0·13	294,460,214	194/0
1869	141,853,383	4·61	948,298,512	30·81	2,524,215	0·08	295,460,214	192/1
1870	166,819,579	5·36	1,099,751,092	35·36	3,638,782	0·17	303,296,082	196/9
1871	184,421,542	5·73	1,406,281,520	44·64	4,961,500	0·16	326,834,647	207/6

Commercial and other Statistics of the United Kingdom.

Year.	Total Value of British and Irish Produce Exported		Ships in Foreign Trade Entered Inwards		Railways in United Kingdom		
	£	Per Head	Tonnage	Per Head	Capital Expended	Per Head	Nett Profit per cent.
1845	60,111,082	41/8	6,045,718	0·22	75,646,100	54/3	5·48
1846	57,786,876	41/	6,101,015	0·22	87,765,100	62/3	5·25
1847	58,842,377	41/11	7,196,033	0·26	114,728,000	81/	4·09
1848	52,849,445	37/11	6.125,945	0·23	154,200,000	110/9	4·06
1849	63,596,025	46/4	6,919,900	0·25	197,000,000	142/7	3·44
1850	71,367,885	52/1	7,100,476	0·26	230,522,730	168/3	3·31
1851	74,448,722	54/1	7,872,094	0·28	236,841,420	172/1	3·67
1852	78,076,854	56/8	7,887,447	0·29	248,083,520	179/11	3·44
1853	98,933,781	71/6	8,943,107	0·32	263,636,320	190/7	3·80
1854	97,184,726	69/11	9,160,366	0·33	273,860,090	197/1	3·93
1855	95,688,085	68/7	8,951,239	0·32	293,903,000	210/8	3·90
1856	115,826,948	82/3	10,553,134	0·38	302,946,260	215/3	4·00
1857	122,155,237	86/2	11,475,199	0·40	311,153,670	219/5	4·19
1858	116,608,756	81/8	10,961,700	0·38	319,950,000	224/	3·91
1859	130,411,529	90/4	11,221,922	0·39	328,219,100	228/2	4·13
1860	135,891,227	93/11	12,172,785	0·42	337,827,200	233/5	4·39
1861	125,102,814	85/8	13,179,589	0·45	352,386,100	241/4	4·30
1862	124,137,812	84/5	13,091,000	0·44	370,107,280	251/9	4·22
1863	146,602,342	99/1	13,256,063	0·45	387,246,200	270/8	4·25
1864	160,434,302	107/7	13,515,011	0·45	408,396,680	273/11	4·49
1865	165,862,402	115/1	14,317,886	0·48	433,558,100	289/0	4·46
1866	188,827,785	125/8	15,612,170	0·52	463,746,800	318/8	4·29
1867	181,183,971	120/0	14,827,617	0·49	479,167,300	317/4	4·18
1868	179,463,644	118/0	13,851,317	0·46	486,893,400	319/10	4·13
1869	190,045.230	123/7	14,485,945	0·47	490,950,770	319/4	4·45
1870	199,640,783	128/5	14,911,675	0·48	504,381,000	324/4	4·49
1871	219,319,071	139/3	16,413,102	0·52	529,908,673	336/6	4·52

COMMERCIAL AND OTHER STATISTICS OF THE UNITED KINGDOM.

Year	DECLARED VALUE OF GOLD, SILVER, AND SPECIE.				BANK INTEREST	INCOME TAX	
	Imported	Per Head	Exported	Per Head	An average per cent	Nett Amount Assessed for Property and Profits	Per Head
	£		£				
1845	Not registered prior to 1858.		4,066,886	2/11	2·68		
1846			2,937,266	2/1	3·33		
1847			8,602,597	6/1	5·15		
1848			8,596,990	6/2	3·69		
1849			8,912,467	6/5	2·95		
1850			6,940,346	5/1	2·51		
1851			9,059,551	6/7	2·99		
1852			10,295,464	7/6	2·24		
1853			18,906,755	13/8	3·43		
1854			22,586,568	16/3	5·11		
1855			18,828,178	13/6	4·78		
1856			24,851,797	17/8	5·83	268,338,109	190/7
1857			33,566,968	23/8	6·66	274,114,003	193/4
1858	29,493,190	20/8	19,628,876	13/9	3·03	292,694,508	204/11
1859	37,070,156	25/9	35,688,803	24/10	2·74	293,666,988	204/1
1860	22,978,196	15/11	25,534,768	17/8	4·18	299,232,878	206/9
1861	18,747,045	12/10	20,811,648	14/3	5·21	301,345,865	206/5
1862	31,656,476	21/6	29,326,191	19/11	5·53	317,070,986	215/8
1863	30,030,794	20/3	26,544,040	17/11	4·40	323,949,129	218/11
1864	27,728,276	18/7	23,157,515	15/6	7·35	326,696,050	219/1
1865	21,462,211	14/4	15,210,994	10/2	4·75	349,301,654	232/10
1866	34,287,139	22/9	21,970,687	14/5	6·90	364,430,553	248/6
1867	23,821,047	15/9	14,327,289	9/6	2·54	374,342,902	247/11
1868	24,852,595	16/4	20,220,014	13/3	2·10	386,542,366	253/11
1869	20,500,991	13/4	16,391,999	10/8	3·20	389,421,002	253/3
1870	29,455,668	18/11	18,334,450	12/2	3·04	398,222,811	256/1
1871	38,140,327	21/3	33,760,671	21/5	2·88	Not yet Published.	

Correspondence.

To the Editor of "The Sugar Cane."

Sir,

As many of your readers would probably like to learn the results of an experiment tried on a tolerably large scale to determine the relative advantages of concrete and sugar, I will make no apology for sending you the following statement, together with a few remarks which are necessary. The estate on which the experiment was made is on the south side of Jamaica, and owing to the autumn rains being unusually heavy and protracted, the juices both on that and the neighbouring estates were less rich than they usually are. The sugar made on this estate was boiled into syrup in an ordinary battery, concentrated in Wetzel pans and cured in centrifugal machines which were used for the first time. The average of a good many experiments gave the return in dry sugar from the machines as being 64 per cent. of the "*masse cuite.*" I have, however, added the analyses of sugar made by the common process on two other estates, B & C, the produce of which has hitherto been much on a par with that of the estate on which the concrete was made, being in one case a little better, in the other a little worse. The analyses of concrete given are those of the two best and two worst shipments; the sugar is in each case that which arrived by the same ship. As the skimmings were not filtered, as I believe is usual where concrete is made, but sent at once to the distillery, an allowance or rather addition must be made to the return of concrete on that account. From the experience of last year I am induced to assign 12 gallons of rum 35° over proof to the hogshead (weighing a little over a ton) of concrete; this I believe to be very near the truth. The experiments made by the Board of Trade to determine the value of sugar for distilling gave, I believe, 7½ gallons of proof spirit, as the equivalent of 112 lbs. of sugar. Allowing for the difference between experiments conducted with great care on a small scale, and the results of working on a large scale, we may fairly, I think, take 5 gallons of spirit, 35° over proof, as the equivalent of 112 lbs. of concrete. I should add, also, that the manager of the estate informs me that whenever any concrete came from the cylinder a little underboiled it was sent at once to the Wetzel pans, and not returned into the tank; this is an error (probably not a large one) which I cannot eliminate, but which is, as far as it goes, unfair to the concrete.

The colour of the concrete was on the whole decidedly better than that of the common process sugar, but slightly inferior to that cured in the centrifugals. It is perhaps scarcely necessary to point out what most people who take an interest in the subject know by this time, that very great care and attention are requisite to prevent the concrete from being scorched by the air passing from the heater into the cylinder at too high a temperature; it is possible also to err in defect as well as in excess. I may add that while the sales of the concrete have ranged from 25s. to 23s. 6d. per cwt. *in bond*, those of the sugar cured in the centrifugals have ranged from 27s. 6d. to 26s.—a little is still unsold. The weights given are those upon which duty has been paid, and those of the hogsheads and barrels used in Jamaica have been calculated from them.

905,700 gallons of cane juice came from the mill, of which
540,600 gallons gave 495,328 lbs. of sugar landed in England, and
3,486 lbs. used in Jamaica,

making a total of 498,814 lbs.,
being 0·92 lbs. or 14¾oz. of sugar per gallon of juice.

365,100 gallons gave 595,440 lbs. of concrete landed in England,
and 2,300 lbs. used in Jamaica,

making a total of 597,740 lbs.,
being 1·66 lbs. or 26½oz. of concrete per gallon of juice.

In addition to this, 198 puncheons of rum were made, of which 32 are due to the concrete and the rest to the sugar, the puncheons containing on an average from 95 to 96 gallons. There is a great advantage in combining the manufacture of concrete with that of centrifugal cured sugar, since it is not necessary to reboil the molasses, the quantity not being too great to be used up profitably in the distillery, as it undoubtedly would be if no concrete were made.

Analyses of Concrete and Sugar.

By "Floral Star."

	Concrete.	A. Sugar cured in Centrifugals.	B. Common Process.	C. Common Process.
Crystallizable	90·532	89·207	89·392	89·750
Fruit sugar	2·702	3·787	5·102	3·521
Water (212° F.)	3·900	2·800	4·150	3·525
Ash	0·858	1·016	0·742	0·893
Unsought	2·000	3·190	0·614	2·311
	100·000	100·000	100·000	100·000

By "Hereford."

	Concrete.	A. Centrifugaled Sugar.	B. Common Process.	C. Common Process.
Crystallizable	90·016	90·315	87·682	89·754
Fruit sugar	3·246	2·631	5·102	3·521
Water (212° F.)	3·450	2·220	4·125	3·350
Ash	1·090	0·864	0·920	0·890
Unsought	2·198	3·990	2·171	2·485
	100·000	100·000	100·000	100·000

By "Loch Awe."

	Concrete.	A. Centrifugaled Sugar.	B. Common Process.	C. Common Process.
Crystallizable	83·305	89·703	85·696	85·407
Fruit sugar	4·902	4·000	5·952	6·250
Water (212° F.)	3·636	3·494	4·333	5·400
Ash	1·200	0·529	0·600	1·173
Unsought	6·957	2·274	3·419	1·170
	100·000	100·000	100·000	100·000

By "Glenbrook."

	Concrete.	Sugar.
Crystallizable	85·20	92·20
Fruit sugar	5·00	3·76
Water (212° F.)	6·10	2·82
Ash	1·20	0·79
Unsought	2·50	0·43
	100·00	100·00

I am, Sir, yours, &c.,

J. W. MITCHELL.

TO THE EDITOR OF "THE SUGAR CANE."

SIR,

The following letter which I have received from Messrs. Young, Harrison & Bevan is of especial interest to myself, but it may possibly not be uninteresting to some of the readers of "*The Sugar Cane.*" If such is your opinion, perhaps you will give it place.

Yours truly,

ALFRED FRYER.

LONDON, 9TH JANUARY, 1872.

DEAR SIR,

In answer to your letter of the 6th inst., we have much pleasure in giving you some results of our experience during the year that is just past of the Concretor and concrete. You are quite at liberty to make what use you please of this letter.

Our estates are in the British colony of Honduras, and of concrete we produced last year 1000 tons within a ton or two. With the exception of a few tons sold early in the year at an indifferent price, the prices we obtained for this quantity ranged from 26s. to 31s. 6d. duty paid, according to the state of the market and the quality of the several lots, though in our opinion the quality was really very uniform. Care and attention with some previous experience are required, as in all other things, to produce a good sample of concrete, but we are satisfied with the quality of our concrete last season. We believe it to be, as indeed is shown by the analysis, good strong sugar, of a nice colour, and free from any property either as respects its form or composition objectionable to the refiner. The prices realized we consider hardly up to the value of the article. We subjoin a table of analyses of sundry lots of this concrete. These analyses are by Mr. Halse, of Mincing Lane, an experienced analyst, and have been verified in two or three instances by others:—

	Crystallizable.	Uncrystallizable.	Water.	Ash.	Unknown.
(1)	87·20	4·00	4·50	1·38	2·92
(2)	89·60	1·90	5·50	·85	2·15
(3)	90·20	1·95	4·03	·99	2·83
(4)	91·70	3·30	2·15	·88	1·97
(5)	87·00	5·00	4·72	1·24	2·04
(6)	95·10	1·40	1·56	·86	1·08
(7)	94·30	1·70	2·21	1·16	·63
(8)	92·50	1·92	2·70	1·18	1·70

The drainage has been more than we anticipated, being considerably in excess of the loss shown on certain parcels in this month's *Sugar Cane*. But we are not fully satisfied with the correctness of our returns of weight, and prefer not to give details.

The concrete that has given the above analyses was made from excellent juice, gauging from 10 to 12 of Beaumé's scale. The soil is very productive, from many of the fields we think 4 tons of concrete will be made per acre, after allowing for the space occupied by tree stumps not yet rotted off. We have made 3¼ tons without making any such deductions.

We are, dear Sir, sincerely yours,
YOUNG, HARRISON & BEVAN.

Alfred Fryer, Esq., Manchester.

BEET ROOTS IN CANADA.

To the Editor of "The Sugar Cane."

Toronto, Canada, 18th Dec., 1871.

Dear Sir,

The beet root sugar question is progressing finely in Canada, and I have every hope and belief that we shall see a number of small factories established next season. I have succeeded in sweeping away all the complications and difficulties of the process, and we can now make a "pure syrup" that crystallizes well, using only in the process ordinary domestic utensils.

After blundering through all the works published on the subject, that I could procure, and going to a great expense, I have discovered, "first," that I was very little wiser than before, and, secondly, that none of the authors knew much more than I did,—the knowledge of our own ignorance is perhaps the most important point that can be gained,—and having fully satisfied myself on that head, I started afresh. I had become satisfied that "Rosseau" was right, that the juice, when exposed for any length of time to heat, "with lime" in it, made slime sugar; and also that the same was produced by the action of carbonic acid on the *hot* juice,—the consequence is, that we allow the lime used in defecation to remain only a few minutes in the hot juice, and we carbonate cold. The results are perfectly satisfactory.

The following is an account of the specific gravity of several samples of beet juice:—

	Specific Gravity of Juice.
22nd Sept., 1871.—Large grown beet, grown almost out of the ground, and never earthed up (8lbs. each root)	1·055
4th Nov., 1871.—Large white Silesian roots, grown in the same way	1·065
17th Nov., 1871.—Small roots, grown under the ground	1·061
16th Dec., 1871.—Very small roots	1·070
Do. do. Small and large roots mixed	1·060

So you see there is no doubt that our soil and climate will produce beets that will yield well.

Our last summer was so dry that nine-tenths of the beet seed sown never came up; but that which did come produced well.

Being determined to get to the root of the matter, I got a friend who was travelling through Germany to visit the factories. He was a popular man, and knew where to look for the truth; and he ascertained from the workmen "that the great enemy of the business is 'Schleim Zucker,'—that they never know when the juice is going to yield well, or going into 'Schleim,' it is all guess work,—the same men, and the same process, will make one batch good and the next bad,—nothing is certain." This was most valuable evidence, and showed that, whoever is *right*, many of the great manufacturers are *wrong*, and that, as at present worked, they have no safe rules.

Acting on this, we proceeded on the information furnished by Rosseau, and the result is most gratifying.

We shall not attempt to interfere with the refiners, but shall manufacture a "pure, rich, unburned syrup," without chemicals, and just fit for the refiners to operate on. This will crystallize in the barrels, and go to the refinery—molasses, salts, and all; but our process leaves but very little salts in it,—it is quite consumable as it is, although I allow that the taste is peculiar, but not more so than many other things in daily use.

Vectis.

To the Editor of "The Sugar Cane."

Sir,

On re-perusing *The Sugar Cane* for December, I find cause for congratulating your correspondent "S." on the success of his efforts to reduce his loss by drainage, supposing that he does not "rob Peter to pay Paul." At p. 655 we have a statement of the production of the island of Demerara in 1867. I will assume that it is a correct transcript of Custom-house returns of imports here. We therein see that Demerara shipped 83,097 hhds. of sugar. When filled, these hogsheads weigh 20 cwt. each, on the average;

but the total, with which this island is credited, is the weight *received here*, which is only 62,323 tons of sugar, and not the 83,097 *tons sent from that island.* This difference of 20,774 tons is the quantity lost, the greater part of which drained into the ships which conveyed the sugar, and was thence pumped overboard into the sea. It may have been only a questionable gain to the dolphins, but it was a positive loss to the Demerara planters, of about £415,480. If, instead of throwing away so much money's value, Demerara had made it an annual contribution to the Imperial treasury, what a delightful country this England of ours would be. Or, if it flowed through the pockets of the planters, what an immense amount of good they could have distributed broadcast among their families, their friends, and—the friendless.

Does Demerara stand out conspicuous in extravagance? By no means. If we take any other locality, we fare no better. Barbadoes, for example, does not equal Demerara in sugar production, and therefore the amount of her loss is less. She sent us only 53,749 hhds., weighing 40,312 tons of sugar. Therefore her loss was only 13,437 tons, or £268,740. Now, as the distance of these islands from England is nearly the same, and the same style of making sugar obtains in both islands, the average loss per hhd. is about the same; we may take it at 5 cwt. of sugar, say £5 in money. Having traced so much similarity between them, suppose we take the sum of the annual loss of these two islands only, caused by the drainage or direct waste of their sugar product:—

Demerara loses annually about	£415,480
Barbadoes „ „	268,740
annual loss of these two islands, after cultivating the , paying and feeding the laborers, and making the r, to be wasted, without the semblance of advantage.	£684,220

t if Mr. Lowe should happen to get hold of this interesting fference about money! he might turn it to some good account the Imperial treasury.

It is but a few days since I strayed into one of our law courts, and found learned Q.C.'s in the centre of such a puzzle as considerably amused me, As near as I could eliminate the facts—for the case was then staggering to conclusion, and counsel were badgering the poor ship's carpenter about limber-boards, and limber-strakes; nor could he make them understand why he had not bolted and caulked the former, which are short, and stand athwartships, whilst the latter lay fore and aft, securely bolted to the ship's timbers—the hold of the ship in question had been filled with sugar at Ilo Ilo, and she proceeded thence to Manilla, to fill "'tween decks" with hemp, a usual cargo. Possibly the hemp was not then ready for the ship, and whilst waiting, the sugar on board was of course draining. Being in bags, the sugar became pressed by the superincumbent mass of "tier upon tier." This drainage was daily pumped overboard into Manila Bay, or into a Casco (barge) alongside, in the interest of some distiller ashore. Be that as it may, time passed, and the hemp came alongside. The hatches were lifted for the first time since leaving Ilo Ilo. Now the discovery was made, that the hold was not so full as at Ilo Ilo. The "top tier" of bags of sugar had "gone down" considerably, leaving room for, I think it was, three tier more. The sugar had leaked away. Some wiseacre jumped to the conclusion that, of course, the ship must have leaked, and had so washed away the sugar to be pumped overboard. Acting on this profound notion, the cargo was immediately ordered to be transhipped, and was actually brought home in another ship. The owners of the first ship now sought to recover damages, &c.

Never did I see such hesitation among the Buzfuz's. They had lost their flippant fluency; "chopfallen Horatio!" The judge did his best to glide through the technical confusion; but the poor ju when left to themselves, were soon at a dead lock. They unable to grope their way to a verdict, and were ultimately ex their task, and dismissed without arriving at a decision.

May I not repeat myself?—"Thus we see how the hesitati improvement of cane sugar surrounds its victims with emba ment."

Your obedient servant,

W. EATHORNE GILL.

16 *Mortimer Road, De Beauvoir Square,*
London, N.

MAURITIUS.

(*From Licht's Monthly Circular.*)

EXPORTS FROM 1ST AUGUST TO 14TH NOVEMBER,

	1871.	1870.	1869.
	Tons.	Tons.	Tons.
To England..........	12,898	.. 5,591	.. 12,781
,, France	9,950	.. 2,337	.. 3,929
,, Australia	7,547	.. 11,127	.. 14,758
,, New Zealand......	1,056	.. 1,355	.. 2,654
,, Bombay..........	14,653	.. 8,663	.. 13,472
,, Cape of Good Hope..	397	.. 1,037	.. 525
,, Other Countries ..	1,221	.. 156	.. 322
Total......	47,722	.. 30,266	.. 46,641

HAVANNA AND MATANZAS.

EXPORTS FROM THE 1ST OF JANUARY TO THE 2ND OF DECEMBER.

	1871.	1870.	1869.
	Tons.	Tons.	Tons.
'o United States of America	183,984	..185,990	..194,489
Great Britain	66,082	..175,938	..159,676
ain......................	45,636	.. 59,395	.. 46,862
nce	11,339	.. 44,454	.. 47,404
thern Europe............	8,979	.. 11,229	.. 10,226
hern Europe............	547	.. 3,405	.. 3,208
er Countries	3,382	.. 8,176	.. 6,309
Total......	319,697	488,587	468,214
tocks in Havanna and Matanzas ..	19,624	.. 13,040	.. 19,791

Estimated Production of Beet-root Sugar on the Continent o
Europe compared with that of two previous seasons.

(From Licht's Monthly Circular.)

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
France	300,000	289,093	289,324
Germany (Zollverein)	195,000	262,986	217,192
Austro-Hungary	160,000	182,280	151,353
Russia and Poland	110,000	135,000	132,500
Belgium	50,000	55,739	43,552
Holland and other countries	25,000	17,500	12,500
Total	840,000	942,588	846,421

Stocks of Sugar in the Chief Markets of the World on the 1st December, in thousands of tons, to the nearest thousand.

	1871.	1870.	1869.
United Kingdom	104	165	125
France	89	67	103
Holland	26	24	18
Germany (Zollverein)	25	20	37
Six other depôts	5	4	3
	250	280	287
United States	78	65	88
Havanna & Matanzas	20	13	20
Total	348	358	395

Consumption of Sugar in Europe and the United States, f
the Years ending 30th November, in thousands of to

	1871.	1870.	18
United Kingdom	684	693	[illegible]
France	309	328	[illegible]
Germany (Zollverein)	269	228	[illegible]
Holland	18	24	[illegible]
Six other Countries	118	112	[illegible]
	1,349	1,385	1,2
United States	522	468	42
Total	1,871	1,853	1,708

SUGAR STATISTICS—GREAT BRITAIN.

To 20th January, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	9	..	2	6	17	23	2	..	1	2	5	6	5	..	..	4	9	8
British East India	4	3	..	..	6	16	1	..	..	..	2	1	1	1	..	..	2	1
Mauritius	4	..	1	3	7	2	1	..	1	1	3	..	1	..	1	..	2	1
Cuba	3	1	1	5	9	8	..	1	1	..	1	2	1	..	..	1	2	6
Porto Rico, &c. ..	1	2	..	1	3	5	..	..	..	..	..	..	..	..	..	..	1	2
Manilla & Java ..	12	9	..	2	23	39	2	1	..	1	4	2	2	1	..	..	4	3
Brazil	..	8	1	5	13	14	..	2	..	..	3	2	..	2	..	..	3	4
Beetroot, &c.	7	1	1	9	19	16	3	1	1	8	12	12	1	2	1	7	11	11
Total, 1872 ..	40	23	5	29	97	124	10	5	3	12	30	25	11	8	3	12	33	37
Total, 1871 ..	64	28	5	27	27 decrease		7	3	4	11	5 increase		12	9	4	12	4 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

During the whole of January the sugar market has been dull, especially for refined goods of all descriptions. For the first week or two, although there was little demand for raw sugars, the stocks and arrivals were so small that there was scarcely any variation in price; but as the month advanced, arrivals increased and the demand from refiners being exceedingly limited, a slight decline took place although transactions were exceedingly limited. No. 12 Havanna afloat is quoted at 29s. 6d. to 30s. about 1s. 6d. lower than at the close of the last year, and 1s. below the quotations of the present date in 1871. Cuba Muscavadoes, and No. 12 Mauritius exhibit nearly the same decline, low descriptions are also somewhat cheaper. The decline in refined especially in pieces has been proportionately greater. Common lump is quoted at 40s. 6d. in London.

The imports to the 20th January show an increase of 5,000 tons as compared with the corresponding period of last year, whilst deliveries show considerable falling off. Stocks are now 27,000 tons below those of last year at this date, whereas a month ago the comparative deficiency was 39,000 tons.

As the season approaches when imports may be expected from our West Indian colonies and from Cuba, it is scarcely likely that a revival of the late high prices can be looked for, at the same time in the absence of any expectation of largely increased supplies and having regard to the confirmed deficiency of the continental beet root sugar crop of at least 100,000 tons, there appears no reason why there should be much further depreciation in value of either raw or refined sugar.

THE

SUGAR CANE.

No. 32. MARCH 1, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

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ON THE MANUFACTURE AND REFINING OF SUGAR.

[*The Cantor Lectures, delivered before the Society of Arts.*]

By C. Haughton Gill.

Lecture I.—Continued.

From this point I will pass on to a few reactions and decompositions of sugar itself, which I must mention, although they are somewhat tedious, and admit of very few experimental illustrations which are visible at any distance. The precautions which are, or rather ought to be, observed in sugar-making depend on a knowledge of these decompositions, to which sugar is subjected when these precautions are not attended to. Sugar itself, in the purest form in which we have it, is a white crystalline body, sometimes occurring in very large crystals composed of three elements only—carbon, hydrogen, and oxygen. The proportion in which they are united I need not trouble you with, but I may say that if other considerations allowed of it, we might regard it simply as a compound of carbon and water, the oxygen and hydrogen being in the same proportion as that in which they combine to form that liquid. When sugar is submitted to a variety of chemical actions, the first change which it submits to is a change of this kind, that the elements of water are either abstracted from it or are added to it. The changes which occur where water is removed from it may be illustrated thus:—When sugar is heated, it first melts, then if the heating is continued slowly and regularly, it parts with one molecule of water, then with another, then another, and so on, becoming successively converted into a variety of bodies, the names of which I need not enumerate, but which, I may remark, are all uncrystallizable, and not sweet, and passing at one stage into a mixture of bodies having very dark colours which I dare say is known to most of you under the name of caramel. This conversion into a dark coloured body, by the action of the heat, occurs, not only where sugar is heated by itself in a dry state, but also when it is heated for a long time in concentrated aqueous solution of sugar, and heat it in contact with a hot surface, a portion of it gets converted into this brown material, and colours the whole mass. One of the main improvements in the manufacture of sugar has consisted in evaporating the solution of that body at so low a temperature that this change of sugar into caramel can only take place to a very small extent. There is another change which I must refer to, of an opposite character, which consists in adding water to the molecules of sugar, not merely in the same way in which we add water when we dissolve it, but in a chemical sense really adding water to its constituents. It is thereby converted into a mixture of two other bodies, very different in character, but having exactly the same composition. The one is known by the name of grape sugar or dextrose, and the other under the name of fruit sugar, or levulose, specimens of which are on the table. These are the two substances which are produced by the addition of a molecule of water to a molecule of sugar; a change which can be effected only too easily in a variety of ways.

When a solution of sugar is heated, or only allowed to stand in an acid state, the change takes place; even very minute proportions of one of the mineral acids, such as sulphuric or hydrochloric acids act with extreme rapidity, converting the valuable, easily crystallized cane sugar into a mixture of these two other sugars, which are uncrystallizable and comparatively worthless.

I have prepared such a mixture here by the action of dilute acid on a weak solution of cane sugar; and then by removing the acid employed, and by concentration of the resultant liquid I have obtained a body which is something like set honey. This change from cane sugar into that mixture of grape and fruit sugar is one which I cannot very readily illustrate, but I will endeavour, at any rate, to render evident that some change takes place. I will take here a solution of cane sugar, which I will divide into two parts. To the one I will add an alkaline solution of a copper salt, that is sulphate of copper dissolved in caustic soda by the aid of Rochelle salt, and which has, as you see, an intense blue colour. I add it to this solution of cane sugar, when you perceive the liquid remains blue, and on boiling it, unless the sugar was impure you will see no perceptible effect produced. I have boiled it, and the liquid is still of as bright a colour as before. Now, to the other portion, first diluting it, I will add one drop of hydrochloric acid, and heat it momentarily to the boiling-point, or hardly that; yóu will now see that a marked change has taken place, for, on adding some of the sugar solution so treated to another portion of the boiling blue copper solution, a bright-red colour of suboxide of copper is formed at once, and the liquid loses its blue tint. The action of a very small quantity of acid for a very short time has so utterly altered the nature of the sugar, that whereas while it remained in its original state it was incapable of action on this alkaline solution of copper, now, when it has once been submitted to that action, it exerts a startling influence; it has, in fact, taken oxygen away from the copper, so that whereas you may conceive that this blue solution contains protoxide of copper, a compound of copper, with a certain quantity of oxygen; in this red precipitate which is formed here we have a compound of the same quantity of copper with half as much oxygen, that is, half the oxygen of the copper is taken away by this altered sugar. Another way of illustrating this is by boiling a portion of unaltered sugar in solution, somewhat diluted with water, with a strong solution of caustic soda. We shall find that it undergoes no alteration if it is perfectly pure. You may find it turn a very little yellowish on account of an accidental impurity, but if it is quite pure no visible change whatever will take place. This I wish you to remark particularly, because one of the principal processes in the preparation of sugar from the sugar beet consists in heating the solution with a quantity of lime, which is, in its action, perfectly analogous to soda, being a very strong alkali. It exerts no action on cane sugar, but a very powerful action indeed on the altered sugar, or, as it is sometimes called, invert sugar. I will now repeat the experiment in the same form, only replacing the unaltered sugar by some which has been momentarily heated with a drop of acid. Both the new sugars are totally destroyed as sugar, and the whole liquid turns dark brown, almost black; in fact, the sugars are literally burned up by the alkalies, although the true cane sugar submits to no alteration.

I must now show another change which sugar undergoes, or rather, it is the same change as that which takes place when it is acted upon by acids, but produced by different reagents. You recollect that a solution of pure sugar, when boiled with an alkaline solution of copper, which has a brilliant blue colour, does not undergo any change. I will now get the solution of copper boiled, and add to it presently a solution of sugar which has undergone another alteration. I have here a solution of sugar which gives no reaction with this blue liquid; it is very gently warmed, about ordinary summer temperature, and I will add to it a small quantity of yeast, stirred up in water, and allow it to stand a minute or two. You know what yeast is—a body which rapidly produces fermentation in a decoction of malt or any sugary liquid. It will not, in this case, have time to induce fermentation, but it will have time, even in a few minutes, to produce the initial change of fermentation; the conversion of this crystallizable cane sugar into the uncrystallizable mixture of dextrose and levulose, the so-called inverted sugar. This copper solution is now boiling, and I must first show you that the yeast itself is not capable of producing precipitation. Being a cloudy body it will render the liquid rather turbid, but it does not precipitate the red oxide of copper, which, as I showed you just now, the altered sugar does in a ready manner. I have here a portion of the same blue liquid boiled in another flask, and now, after the sugar has been only a minute or two in contact with the yeast, on pouring some of it into the copper solution, you perceive the whole of the blue colour has been destroyed, and the liquid has turned red, owing to the precipitation of the suboxide of copper. The importance of these experiments is this, that it illustrates how excessively pernicious to a sugar-maker it must be to allow even incipient fermentation to occur. If the least trace of fermentation occurs, it inevitably causes the conversion of a very large proportion of valuable crystallizable sugar into the almost worthless uncrystallizable variety.

LECTURE II.

Time will not allow me to dwell longer on the chemical reactions of sugar, and I must now pass on, and give you an outline of the process of manufacturing sugar from the cane. As I stated last time, I have no first-hand knowledge of this process, and consequently can only give you an outline description, referring you to others for exact technical information. The sugar-cane, which you have all seen, either in the Botanical Gardens or represented in drawings, I need not stay to describe; it is a species of grass growing to a height of from six to ten feet. When ripe it is cut; the tops are lopped off, and the canes, tied up in bundles, are carried to the mill. The process most usually employed for extracting the juice from the cane is a very rough mechanical operation. The canes are brought up to a set of three rollers, so placed as to form two pairs, the first being set wider apart than the second, so as to only just bruise the canes, whilst they get a much severer pinch on passing through the second pair. The juice, being thus squeezed out, falls into the bed-plate of the mill, and from thence is carried to the pans in which it is clarified before being boiled down, whilst the trash or cane residue is dried and used as fuel. The juice is carried first to a series of large round vessels of about 400 gallons' capacity each, where it is brought nearly to the boiling-point, and treated with a small quantity of lime, to neutralise the acid and to assist in making the albuminous constituents set, so as to form scum which it is possible to remove. The juice, which was previously of much the same dark colour as the beet-root juice which I showed you last week, leaves these clarifiers transparent and of a more or less pale yellow colour. From these defecating pans the juice now goes to the first and largest of a series of hemispherical pans, bedded in brickwork and having a flue passing beneath them, from a furnace close to the smallest pan of the series to the chimney shaft at the other end.

The clarified juice goes, as I said first, into the largest vessel, where it is boiled until a considerable proportion of the water has been driven away. When another lot of juice is ready to come on, the contents of the pan are ladled into the second, and so it is gradually ladled from one pan into another until it comes to the smallest vessel, called a "tayche," which lies immediately over the fire. By this time it has got very thick indeed, being about the consistency of treacle; and you can imagine very easily what must happen to it after all this work.

The cane juice which runs from the mill is slopping about over the place; bits of dirt, &c., have time to accumulate, and it turns a little sour; in fact, the whole juice, to begin with, is rather acid, and a portion of it begins to ferment. A change (such as that which I illustrated last week with the yeast) takes place to some extent, and a portion of crystallizable sugar is "inverted." When the juice goes into this pan it is still slightly acid, and, as I showed last week, the action of acid at a high temperature is to convert another portion of the sugar into that uncrystallizable modification, and the longer the action is allowed to go on the more sugar is thus converted. The juice is a long time passing from the first pan into the last, and therefore there is plenty of opportunity for this change to take place. Again, a high temperature is prejudicial to the sugar, as it destroys the crystallizable power of a portion of it; and, moreover, destroys another portion altogether as sugar. When the sugar has got as far as the last and smallest pan, it is so thick that it will not boil in the open air at a temperature of less than about 230° to 235° F.; this is a temperature at which it is subject to great alteration and decomposition, and not only so, but we must also consider how much higher a temperature part of it is really being subjected to. Every mistress of a family knows perfectly well that thick things, like starch or soups, will "burn" if not kept stirred; and you can readily understand why that is. They do not move about freely enough in the pot to get heated equally throughout. The bottom of the pot gets exceedingly hot, the fire upon which it is placed being three or four times as hot as boiling water, and any liquid which is pasty or thick, such as this sugar juice, cannot move freely, and flow up from the bottom, so as to cause a continual renewal of the parts exposed to the heated surface. Some portion, therefore, remains too long in contact with the highly-heated metal, and gets burnt, and the consequence is that the juice which enters the first of these evaporates as a clear yellow liquid; when it is dipped or "skipped" out, as it is termed, of the "tayche," it has assumed the appearance of very dark treacle. The ordinary constituents of cane juice are—Water, 81 per cent, ; sugar, about 18; organic bodies, like gum, 0·6; and inorganic, like salts, about 0·4. This is only a rough general analysis, which takes no notice of the presence of any inverted sugar, and so far, therefore, it is incorrect, inasmuch as cane juice always contains a small quantity of this altered sugar ready formed, amounting generally to about 0·5 or 0·6 per cent. of the whole amount of sugar that is, in sound, ripe canes; in those which are rotten, or half rotten, the proportion is much higher. After the liquid has been boiled in the first of these evaporating pans, it has been found that there is sometimes as much as 10 per cent. of this altered sugar for every 100 parts of real sugar, while in the last, the "tayche," where it has received its final concentration, and attained the highest temperature, and been subjected for the longest time to all these mischievous influences which I have mentioned, the proportion of this altered sugar has risen to 22 or nearly 23 per cent. The mischief of this is, not only that you have destroyed so much of the sugar, but the presence of this altered sugar renders it extremely difficult, even if it does not absolutely prevent, the recovery of another equal portion of still unaltered cane sugar in a marketable form. The liquid containing a considerable proportion of the altered sugar has the consistency of treacle, and it is not easily deprived of so much of its water by evaporation as to leave the unaltered sugar in a state of a hot saturated solution, capable of crystallizing or cooling. Even if crystallization is actually obtained, the crystals are formed in a thick, adhesive, semi-fluid mass, from which you cannot separate them; consequently the mischief of converting a portion of your cane sugar into this altered sugar is not confined to the simple loss of the quantity so converted, the actual loss being nearly double; for one part of this altered sugar appears practically to prevent the crystallization of an equal weight of cane sugar.* This is one great source of loss, but previous to this there was another. I have said nothing at present about the yield of juice by this method of pressure between rollers; but it is a very poor one indeed. Average canes of good quality contain about 90 per cent. of juice, and there being only about 10 per cent. of actual woody matter; yet it is considered a very good yield to get out 60 per cent. If, therefore, you only get 60 per cent. out of 90, you have left in the residue half as much as you have won. That would not answer in most manufacturing operations, and it is a very poor yield as compared with what is obtained in working beet-root. Only two-thirds of the sugar is got out of the cane in the form of juice, and when that is obtained the manufacturer immediately proceeds to waste a great portion. At a moderate computation, an acre will grow 30 tons of sugar-cane, and in those you will have 90 per cent. of juice, containing, say, 18 per cent. of sugar; working this out, I find that the sugar produced from an acre is about 4·86, or nearly five tons. Then, taking the 60 per cent. yield of juice, and allowing very moderately for loss, the sugar actually won is only equal to two and a half tons, so that the quantity of sugar sent into the market is about one-half of that which is taken off the ground. As the concentrated juice is "skipped" out from the tayche, it is transferred to round, shallow coolers, and allowed to stand until it is of the right consistency, when it is put into hogsheads, the bottoms of which are pierced with a number of holes, loosely stopped with some convenient material, such as the stalk of a plantain leaf, and there it is allowed to remain for a considerable time, in a warm temperature, over a grated floor, until, in fact, the crystals of sugar are formed, surrounded by a cool saturated solution of sugar, containing also many impurities, being what is called syrup. This syrup is allowed to drain away gradually, leaving behind a mass of soft brown sugar, which is known in the market as raw sugar. The quality of this product so obtained varies greatly on different estates, with the amount of skill applied in the manufacture, the quality of the cane, &c. Sometimes it is very bad indeed, as you may see by a sample on the table, and colour varies with the quality. There is one sample of nearly pure sugar which is really raw cane sugar; but it was not made in the mode I have described, the manufacturer having exercised some little skill and judgment, and brought into use some of the more modern appliances which science has devised.

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* This statement must not be taken as an expression of a fully-ascertained fact as regards the quantity.

I will next describe an important method of getting the juice out of the cane, by which a much larger yield is obtained, whilst the juice itself is much purer, containing a smaller proportion of the organic salts, which are the bodies which most assist fermentation, which, as you know, produces a serious loss of sugar. The process is known by the name of diffusion, and it will, I dare say, suggest to you the means by which the juice is won. It is carried on upon a large scale at the Aska Sugar Works, near Madras, and Mr. Minchin, the able and energetic manager, assures me that it really leaves little or nothing to be desired. The yield of juice, instead of being only 60 per cent., amounts to over 85, leaving only 5 out of 90 per cent. instead of 30, as in the old process. This is a very considerable gain at once; but, in addition, the juice is much purer than that got out by means of rollers; it is therefore more easily worked, and a larger quantity of sugar of finer quality is obtained. And when you recollect that every ton of sugar lost represents a loss of about £25 to the manufacturer, you will see that it is a matter of primary importance to get every cwt. possible. The principle of the method is this. The canes are cut up by suitable machinery into thin diagonal slices. These are filled into a cylindrical iron vessel, about 6 or 7 ft. high, and from 4 ft. to 4 ft. 6 in. diameter, the size being merely a matter of convenience. Room is left for the addition of so much water as will keep the slices afloat, so that they are surrounded by water on all sides.

The vessel is allowed to stand for fifteen or twenty minutes, while a second vessel of like capacity is filled with cane cuttings, but no water being added. By this time a considerable proportion of the sugar contained in the cells of the plant has passed out through the cell walls into the surrounding water by the process of diffusion, similar to that which I exhibited to you, the organic non-saccharine bodies, which are mostly colloids, remaining behind. But as you will, doubtless, have remarked, this process of diffusion must come to an end when the water surrounding the cells contains as much sugar as that in the inside, and practically, the extreme limit is not quite reached. However, when the water in the first vessel has got considerably charged with sugar, it is passed into the second, which contains fresh cane cuttings filled with highly concentrated juice. Diffusion then begins in the second vessel, the sugar in the cane cells being undiluted passes out into the diluted liquid and increases the strength of the solution, and at the same time the first vessel has been filled up with fresh water, so that the sugar remaining in the cane cells in it may also diffuse out. The stronger solution in the second vessel is then passed on into a third diffuser, containing fresh cuttings, and sometimes into a fourth, which is about the limit to which the process can advantageously be carried; and from thence, being now sufficiently concentrated, it is drawn off and taken to the clarifiers, and thence to a vacuum pan, for I need hardly say that where such a scientific method of obtaining the juice is followed, it is not boiled in the open air. While this is going on, the second supply of water has been passed on to the second diffuser, and so on consecutively, until it is found that the water from the first vessel contains no more sugar, and when that vessel is disconnected from the series and emptied, the second becomes the first of the series, and so on in succession, a vessel of fresh cuttings being added at the end, when one is removed at the beginning. It is a somewhat complicated system to describe, but it is very simple in work, and is found to yield very good results.

In some of the colonies, both English and French, improved methods of manufacturing sugar from the cane are coming, though slowly, into use; and taking into consideration the weight of canes which can be grown to the acre, the richness and the purity of the juice of these canes, it seems hard to believe that the makers of sugar from the comparatively poor beet will be able to hold their own, when they no longer possess a monopoly of skill and science. These improved processes of manufacture I must leave undescribed, time only allowing me to sketch in outline one of the many methods in actual use.

I must now pass on to some chemical facts which will concern us in the manufacture of sugar from beet-root, which is a more complicated process than that I have described as applied to the juice of cane. I have treated of the cane sugar manufacture in this order simply to show you how very small an amount of chemical knowledge is necessarily brought to bear in the manufacture of sugar from cane. All this, and much more, is required in the case of the beet-root sugar manufacture.

In the first place I must show you that lime, which is an agent very largely employed in the manufacture of sugar from beet-root, is much more soluble in solutions of sugar than in water. I cannot very well exhibit this to you in quantitative fashion, for naturally quantitative experiments consume a good deal of time, but I can show you that lime is taken up very largely by a solution of sugar. In a solution of sugar, to which I will add some slaked lime, after filtering it, we shall find that a considerable portion of the lime has passed into solution. Lime is an alkaline body, *i.e.*, possessed of powers like those of potash or soda, having the power of neutralising acids very effectually indeed; it has also the property, when in solution, of preventing fermentation. Thus a solution of caustic lime will prevent a solution of sugar from fermenting. Here is the filtered solution of sugar into which I put the lime, and I shall be able to show you that it is alkaline. Here is a slip of paper impregnated with tincture of turmeric. It is, as you see, of a yellow colour, but in the presence of alkalies it becomes of a reddish brown. You see it turns brown on being dipped into our solution. Here, again, is a slip of paper reddened with litmus, which has the property of turning blue on the application of an alkali, and this also answers to the test. I do this that you may see how readily the presence of lime can be detected, because I want to show you by-and-by how completely we can remove lime from a solution of sugar after it has been added. In the manufacture of beet-root sugar, lime has to be added at one stage in considerable excess, and it has to be removed afterwards with tolerable completeness, and you thus see how we can detect its presence.

I must now show you another property of lime, viz., that of very readily absorbing carbonic acid gas. I have here a ready-made solution of lime in sugar, which I take because it happens to be a convenient form in which to employ the lime. I will now prepare a little carbonic acid gas, with which I will fill a long glass tube; then, pouring some of the solution of lime in sugar into this glass basin, I introduce the mouth of the tube into it, so as to allow a small portion of the solution to enter, and on closing the mouth of the tube with my finger and agitating it, you will find that the lime present absorbs the whole of the carbonic acid gas. The liquid, you see, has turned quite milky, owing to the fact that the carbonic acid combining with the lime has converted it into carbonate, and the carbonate of lime is not soluble in sugar. You see at once, therefore, that there is a method of removing an excess of lime from a solution of sugar; and this process is all the better for this reason, that carbonic acid is so very weak an acid that it is not capable of inverting the sugar itself. So that, when you have a solution of sugar containing lime, you can remove the lime without fear of injuring the sugar, by passing carbonic acid gas into it until no more is absorbed. On opening the mouth of the tube under water, I find that I did not pass in quite enough sugar-lime to absorb the whole of the carbonic acid gas, but there is only a very small quantity left.

A reaction which illustrates the same thing in another way, though, perhaps, not quite so clearly, is by passing the gas into a solution of sugar-lime, which I will now do, putting some of the sugar-lime into a glass vessel, into which I insert the delivery-tube of the apparatus for evolving carbonic acid gas. You will observe that precipitation will not take place for a short time, and for a reason which is not thoroughly explained at present, but the fact, I believe, is that an intermediate compound is formed between lime and carbonate of lime. Carbonic acid can be passed into a solution of sugar containing lime, until nearly a third of the lime is really converted into carbonate, without any precipitation taking place, and then, almost of a sudden, the solution will become thick and opaque, and the lime will be deposited as insoluble carbonate.

I will now briefly describe the properties of animal charcoal, which is a body of considerable importance in sugar-making. Animal charcoal is prepared from bones, and bones, as you know, consist mainly of two parts, one being an animal part, a sort of gelatinous material, which is stiffened by the other, an earthy body, diffused throughout the mass. I have here a mutton bone, out of which I have taken the earthy material, and you observe that although it keeps its form, it is quite flexible and elastic, that is the animal part. When the animal part is destroyed, which can be done by exposing the bone to a high temperature in contact with the air, the animal matter is entirely burnt away, and there is left behind an extremely brittle material, the earthy phosphate of lime. The earthy material of bone consists essentially of phosphate of lime, which is left behind when the animal portion is entirely destroyed by oxidation at a high temperature. But instead of carrying the burning process to this stage, if we may simply expose a fresh bone to a high temperature without allowing the access of air, as is done by ordinary charcoal burners, the volatile constituents of the animal body will go off in the form of various gases, and a considerable portion of carbon will remain behind in the solid form. But of course the earthy matter also remains behind, and consequently we shall get such a mass as I have here—a bone which has been heated to redness for two hours, but without the access of air; the volatile constituents, the oxygen, the hydrogen, the nitrogen, and some of the carbon, have gone off, leaving behind a great part of the carbon dispersed over the surface of the particles of phosphate of lime. We have, therefore, in animal charcoal a quantity of very finely divided carbon spread over the surface of the phosphate of lime. Bones which have been treated in this way, and subsequently crushed into coarse grain, such as I have here, are largely employed by the manufacturers and refiners of sugar under the name of animal charcoal. I have here some of the animal charcoal from which the phosphate of lime has been removed by the action of acid; it is an exceedingly light powder, so much so that the bottle, on giving it a shake, appears full of it, and on removing the stopper it escapes almost like smoke. The action of the animal charcoal resides entirely in this carbon, the phosphate of lime with which it is usually conjoined having no other use than to render the material firm, hard, and heavier than the sugar solution, and consequently usable on a large scale.

The action of this animal charcoal, to which I wish particularly to direct your attention this evening, is the power which it possesses of absorbing from an aqueous solution certain bodies which are exceedingly prejudicial to the sugar maker, viz., the organic bodies, the colloids which get into the juice more or less in the process of manufacture. Again, as a sample of these colloid bodies, I will take dextrine, not because it is better than others, but because I can more readily prove to you its presence or absence. In this flask there is a solution of dextrine, which I will prove, as before, by its action in the presence of iodine. I will now pour it into this tube, which contains a quantity of finely granulated animal charcoal, and, by turning a cock at the bottom, will allow it to run through slowly. I cannot on the present occasion allow sufficient time for the action to be complete; but if it stood for some hours the absorption of the dextrine would be very complete; as it is, it will probably be only partial; still, on treating the solution which has run through with iodine, you will see that there is a very perceptible difference in the quantity remaining in solution, as evidenced by the intensity of the colour produced.

In my next lecture I shall treat of the manufacture of sugar from beet-root by one of the most approved methods. I see that I shall not be able to enter into the question of the different modes of extracting juice from the beet, and their relative advantages and disadvantages, but must confine myself to the process most largely in use, and from that pass on to the method of purification most usually employed. I will now add a little iodine to the solution which has run through the animal charcoal, and you see it is scarcely coloured, showing that the dextrine has been in great measure absorbed.

(*To be continued.*)

THE ANALYSIS OF SUGAR AND MOLASSES.

[A TRANSLATION OF THE REPORT PRESENTED BY M. WOUSSEN TO THE CENTRAL COMMITTEE OF THE SUGAR MANUFACTURERS OF FRANCE.]

(*Continued from page* 71.)

12. Analysis of 4-5ths without the Polariscope.—Before terminating this report, we must warn manufacturers against an abuse which is we know carried on in the laboratories of some public analysts. Certain of them, to obtain their assays more quickly, neglect the use of the polariscope, and proceed in the following manner.

Instead of directly ascertaining the water, the sugar, and the ash, and then the organic matter by difference, they calculate the sugar by difference: they have often remarked that the organic matter calculated by difference is nearly equal to 4-5ths of the figure of the ash, from this they have deduced a rule by which they calculate the sugar as under:—

The water is determined say	2·00	per cent.
The ash " "	2·50	"
The organic matters are represented by 4-5ths of 2·50............	2·00	"
Total........	6·50	"
Then the difference will be........	93·50	"
	100·00	

This figure, which they call the saccharometrical *titre*, they place at the head of their analysis, not at the foot, as shown above.

If it were true, which it is not, that the organic matter is always and of necessity 4-5ths of the weight of the ash, this method would be incorrect; because if the analyser has made any errors in the amount of water and in the incineration, these errors affect the assay of the principal ingredient, the pure sugar, and that without the control of the polariscope to give the least suspicion of error; but further, the relation between the amount of organic matter and ash is not invariable, on the contrary it varies considerably according to the nature of the beet root worked and the mode of working.

A manufacturer, for example, whose system involves the thorough filtration of his juices and syrups, will necessarily have less organic matter in his syrup in proportion to the salts, than another whose filtration is less perfect, because as is well known the charcoal retains the organic matter much more easily than it does the salts; it might then happen that the sugar of the manufacturer who filters well, would only contain, of organic matter, half the weight of ash instead of 4-5ths, and to take the above example 1·25 per cent. instead of 2, so that the sugar in question if it had been assayed by the polariscope would have shown the following results:—

Sugar....................	94·25
Water....................	2·00
Ash......................	2·50
Organic matters............	1·25
	100·00

This difference in analysis would be equivalent to nearly 1 franc per bag.

Observations on Commercial Customs.

The report given above, and which we present to the manufacturers of sugar, gives the details of the chemical processes, and shows the necessary precautions to be observed in making an analysis of sugar according to actual commercial usage.

We must now enter into certain scientific and industrial considerations relative to some of these commercial usages.

Of these the most important is that which regards the salts as a preventive of the crystallization of the syrups, and this in the proportion of 5 of sugar rendered inert by each 1 of salts which the syrup may contain.

Another thing is the practice of reducing all the salts into sulphates before incineration, to determine them in this state.

We will speak first of this transformation into sulphates, since in the discussion of the co-efficient 5 for the action of the salts we shall often advert to this reaction.

1. TRANSFORMATION INTO SULPHATES.—The salts contained in the raw sugars and in the molasses with which they are impregnated are generally; nitrate of potash and nitrate of soda; with chloride of potassium and chloride of sodium; also some of the organic salts of these two bases, that is to say potash and soda combined with organic acids.

Besides these salts the raw sugars may perhaps contain free potash, free soda, and free lime.

When in order to make an incineration according to commercial custom the sugar which is being assayed is treated with sulphuric acid, the following consequences ensue:—

Sulphuric acid is substituted for all the acids mentioned above and becomes combined with the bases with which they were combined; further it combines with the free bases which may exist in the sugar; as to the excess of sulphuric acid, that is expelled by heat: so that after the incineration, the ashes obtained are not the salts which existed in the sugar or molasses; they have nothing in common with these except their bases. These ashes are now: sulphate of potash, sulphate of soda, and sulphate of lime.

Whether the weight of these ashes is superior or inferior to the weight of the salts contained in the sugar at first is not known.

It would be necessary in order to ascertain, to have previously made a complete analysis of all the mineral and organic salts contained in the sugar, an enormous labour, especially the assaying of the organic salts.

In fact the acids which were originally combined with the bases have been driven off by the sulphuric acid, and have not been replaced by the same weight of the latter. Thus the sulphate of potash of the ash proceeding from the chloride of potassium which existed primitively in the sugar weighs more than the chloride of potassium; on the contrary the sulphate of potash, proceeding from the primitive nitrate of potash weighs less than this nitrate of potash.

Again the sulphate of potash, or the sulphate of lime, which proceed from the sulphating of the free potash and lime existing in the sugar, weigh much more than the free potash and lime did at first, since they, the sulphates, contain the weight of the acid in excess.

In the impossibility then which exists of calculating the increase or decrease of weight which results from the sulphating, and in view of the fact that the exhaustive analysis of one sugar would be incorrect for another if the pre-existing salts were not the same; the difficulty has been met in the following manner:—

Some sugars and molasses have been incinerated without the addition of sulphuric acid, certain precautions being observed which would render an industrial assay very tedious, but the ash obtained no more represents in this case the salts existing before incineration, because the incineration has decomposed some of them, eliminated their acids and replaced them by others (for example the nitrates and the organic salts are found transformed into carbonates) but these are in reality the *ashes of the salts;* afterwards the same sugars and molasses were incinerated, sulphuric acid having been previously added, and it was proved that in general the sulphated ash weighs more by one-tenth then the ash not sulphated; hence has arisen the custom of subtracting one-tenth from the weight of the sulphated ash in commercial analysis: this is customary because a complete chemical analysis would be too tedious and too difficult; it would in fact be impossible to apply it to the numberless samples of sugar which have to be analysed in the way of business.

2. The Presence of Lime in Sugar is a cause of error in the Determination of the Ash. How to Determine this Lime.—It must be acknowledged that the sulphating of the ash is in certain cases a cause of error in the appreciation of the value of

sugars, all the greater because the weight of the ash is afterwards multiplied by 5.

The principal cause of error is the presence of lime in the sugar.

The lime may be found in the sugar under various forms, either in the state of free lime combined with the sugar or rather with the molasses, in the state of sucrate of lime; or in the state of carbonate of lime proceeding from the action of the air on the above-named sucrate; and lastly, for the greater part, in the state of the organic salts of lime—that is to say, in combination with various organic acids proceeding either directly from the beet juice, or from the transformation of the sugar into divers organic compounds during the course of manufacture.

The free lime and the carbonate of lime are harmless, the organic salts of lime are, it is true, injurious to crystallization; perhaps as much so or more than the mineral salts; but they are much more easily eliminated than the latter by the char in the process of refining.

From this it results that a great error is committed in appreciating the value of sugar destined for refining, by considering the free lime or even the salts of lime as a cause of depreciation equal to that which mineral salts are admitted to be.

Of this the following may be taken as a proof:—

It is often seen in the sugar trade that the same refiner will buy and sell raw sugars at the same time at the same price—all on analysis, as he never trades in sugar otherwise—this anomaly is surprising, and on enquiry into the cause it is said that the refiner is endeavouring to lower the market, by selling, and that he takes advantage of the fall caused by himself to buy elsewhere. This may be the cause sometimes, but generally his tactics are based on chemical rather than commercial reasons.

Those refiners who possess well appointed laboratories and who follow the working of the sugars in their refineries with great care, have remarked the error in valuation of which we have spoken above, which consists in treating all the salts, mineral salts, and organic salts of lime on the same footing, in the determination of the value of sugars. They have special analyses made in their laboratories of each lot of sugar they buy in order to determine in what proportion the ash is due to mineral salts or to the organic salts of lime, and at certain times they re-sell all those lots of sugar in which the salts are nearly all mineral salts and replace them by buying other sugars, from which they make the same selection.

The following is the process by which the amount of lime is determined: weigh 25 grammes of the sugar to be assayed, and put it into a long straight gauge graduated to 100 cubic centimeters, then dissolve it in distilled water so that there shall be 75 to 80 c.c. of the solution. To this solution add 5 or 6 c.c. of caustic ammonia, and 15 or 20 c.c. of a saturated solution of oxalate of ammonia: mix the whole well together until entirely dissolved.

The gauge is then allowed to stand, so that the oxalate of lime which is formed may be deposited at the bottom. In order that the deposit may be made rapidly it is better to place the gauge in a warm place.

When the precipitate is collected at the bottom the liquid is carefully poured off from the gauge after it has been proved to contain no more lime by small quantities of fresh oxalate of ammonia. To the precipitate at the bottom of the gauge a little distilled water is added and it is poured on to a small paper filter. When the liquid has passed through, the sides of the filter paper are washed with distilled water in order that all the sediment may pass down to the point at the bottom of the filter paper. When the liquid passed through the filter ceases to turn litmus paper blue, after being drained awhile, the sediment is carried in the funnel into a stove, when it is subjected to a heat of 100° to 110° C. (212° to 230° Faht.) in order to dry it thoroughly. When the sediment is so dry as to leave the funnel, the filter paper is carefully opened on to a sheet of white paper. The small piece of oxalate of lime is taken off with the thin blade of a knife, placed on one side, and covered with a reversed glass, then the filter paper is burnt on a platina capsule which has first been tared. When it is completely incinerated it is left to cool in the capsule, the precipitate of oxalate of lime taken from the filter paper being placed with it. Then with great precaution throw on to it about 10 cubic centimeters of hydrochloric acid mixed with half the quantity of water, then add 5 or 6 drops of concentrated sulphuric acid, or it may be mixed altogether previously, the capsule must then be placed in a stove at 110° C. (230° F.) When quite dry the capsule is allowed to attain a red heat for a moment; and when it has become quite cold it is weighed. Suppose that the weight of sulphate of lime thus obtained should be 11 centigrammes; as 25 grammes of sugar were taken, the weight of sulphate of lime to 100 grammes of sugar will be 0 gr. 44 centigrammes, or 0·44 per cent.

If then the sugar in question gave by incineration 2 per cent. of ash for example we know that in this ash there is 0·44 less one tenth, or 0·4 per cent. of sulphate of lime, and in this case there should be, in our opinion, two separate calculations made of the value of the salts from which the ash is formed, as is done in the laboratories of the refiners.

The 1·6 per cent. of the non-calcareous ash should be multiplied by the coefficient 5 or rather, as we shall show further on, by 3·6 and the 0·4 per cent. of ash from the calcareous salts, lime, or insoluble matters, such as sand which are thus weighed with the lime, must be multiplied by another coefficient.

We say by another coefficient because we must acknowledge that if the lime and the salts of lime are easily eliminated by the charcoal, it is not the less true that the refiner will need more charcoal than if this lime did not exist in the sugar. It is needful to allow for that.

The determination of the lime may appear tedious because our explanation of the process is given at some length, but it does not in fact require much labour, because the only operations requiring much time are the depositing of the precipitate and the drying of the precipitate after the addition of the acids, which will go on without the surveillance of the analyst, who may therefore while they are in progress be occupied with other matters.

Besides when this sort of assay has been made and carefully noted several times, by making several comparative experiments as to the depth of the deposit in the gauge and the weight of the precipitate formed later on, it may at length be sufficient to determine only the depth of the deposit; but for this it will be needful to use a long straight narrow gauge in order that the cubic centimeters divided into tenths may occupy some space especially towards the bottom. Thus we know very nearly, that if a deposit occupies $\frac{3}{4}$ of a cubic centimeter, for example, after being allowed to settle 2 hours at a temperature of 50° C. (122° F.) it will give a certain weight of dry precipitate if the assay is continued. Besides by drying the precipitate of oxalate of lime and weighing it, we may calculate what would have been the weight of sulphate of lime had the operation been completed: thus 1 of oxalate of lime corresponds to 0·93 of sulphate of lime, so that the weight of oxalate of lime multiplied by 0·93 will give that of the sulphate which would have been formed from it.

As to the estimation of the quantity of free lime, that is very difficult because it can only be found separately by alkalimetrical assay, and in this case it will be needful to ascertain the other alkalies, such as potash and soda, which may be present with it in the sugar, and which require tedious and minute analysis. Still the proportion of free lime which may be found in sugar is very small; it corresponds to the excess of lime which may have been used in the syrups by the manufacturer; and we know that this excess cannot pass a certain proportion without impeding the boiling.

The largest quantity of free lime which may be used harmlessly is 1-1000th in the juice at 25°, or say 2-1000ths in the *masse cuite*; that is to say, 1000 grammes or 1 kilog of *masse cuite* may contain 2 grammes of lime in solution, forming sucrate of lime. This sucrate of lime will not crystallise but is found in the molasses which is mixed with the sugar: if then 100 grammes of sugar retain 10 grammes of molasses there will be present 0 gr. 0·2 centigrammes of lime, *i.e.*, 0·02 per cent.

(To be continued.)

ON CANE MANURE.

BY DR. T. L. PHIPSON, F.C.S., &c.

(Formerly of the University of Brussels.)

I have already made known in a series of papers published in this journal, the practical results at which I have arrived, after a careful and prolonged analytical examination, of the cane soils of British Guyana, the West India Islands and Australia, and after having been put into possession of facts connected with the treatment of these soils since they were first placed under cultivation. In the first place, I drew attention to the exhaustive properties of sulphate of ammonia—a very valuable manure when properly employed with others—alluding to the opinion of Baron Von Liebig, whose views coincide with my own experience, that when employed alone it ends by reducing the productive power of the very best soils.

I then discussed briefly the properties of the other manures and stimulants which have been experimented with; and finally, I made known that which, in the absence of good farmyard manure, I consider for any species of soil, to be the best product yet known for the sugar cane.

During the publication of these papers, and ever since, I have continued to devote considerable attention to this subject, and have carried on an active correspondence with planters in various parts of the world, the general tenor of which shows me that there are still a few points to which it is necessary to allude.

I may take this opportunity of stating that great care is now generally bestowed upon the manufacture of those artificial manures which consist of mixtures of superphosphate with Peruvian guano, or of superphosphate with sulphate of ammonia; and perhaps nothing could be more perfect in this respect than the products manufactured by Messrs. Arnott & Co., of Liverpool and London. I have been informed that in many instances these compounds have given very excellent results.

But the object which the agricultural chemist must now have in view is the production of a manure that will not only cause the soil to yield its utmost for a time, when worked with proper care, but one which shall also prevent its ultimate exhaustion. The market gardens around London, particularly those near my own residence, supply us with a proof that this can be done with farmyard manure in our climate; and it is this object which the Urban cane manure is, in my opinion, calculated to fulfil in the tropics.

I will commence this part of the subject by referring to a test by which the Urban manure can be readily distinguished from any other: it consists in its property of yielding a certain amount of its organic substance to strong alcohol (rectified spirits of wine), and forming therewith a dark coloured solution. No other manure known, except farmyard dung, presents this property; and though it might be artificially given to a small sample, it would be impossible to give it to a bulk of some 50 or 100 tons.

A few weeks ago, an analysis of the Urban cane manure was forwarded to me from Demerara, and I was asked whether it represented its composition? Now this analysis had been performed on a genuine sample of Urban manure, but it had been treated as if it were a superphosphate, and the usual incomplete and unsatisfactory commercial analysis as applied to the latter had been applied to it, consequently no idea either of its composition or its value had been arrived at. This fact induces me to refer rather more fully than I have yet done to the chemical constitution of the Urban cane manure, and it will readily be seen that nothing short of an *ultimate* analysis can give the most remote idea of its nature.

The *immediate* analysis of the Urban cane manure shows that it contains all the ingredients found in well made farmyard manure; and if we suppose the latter deprived of its abundant moisture, the composition of the two would be very similar. These ingredients are urea, urate of ammonia, acetate and lactate of lime, soda and potash, ulmate of lime, fumate of ammonia (discovered by Baron P. Thenard), phosphate of ammonia and magnesia, phosphate of lime, sulphate of lime, sulphate of potash, sulphate of soda, albuminous and carbonaceous matters in a state of decomposition, chloride of sodium, chloride of magnesium, soluble silica, phosphate of soda, oxides of iron, manganese, and alumina, moisture (from 10 to 15 per cent.) and sand (about 8 per cent.).

I will now refer to its *ultimate* analysis. As I have stated in former papers, the composition of the Urban manure is made to differ slightly for the various soils when their composition is known with accuracy. To-day I will give three examples of large average bulks—No. 1 for an estate in Demerara, No. 2 and No. 3 for estates in two of the Islands. By the side of these I have placed the ultimate analysis of a sample of good farmyard manure from Surrey :—

	URBAN CANE MANURE.			FARMYARD
	No. 1.	No. 2.	No. 3.	MANURE.
Water	10·50	12·14	12·00	66·17
Organic matters	31·10	40·00	26·60	28·24
Phosphoric acid	8·70	10·41	11·61	0·27
Sulphuric acid	11·76	8·89	9·80	0·11
Chlorine	1·50	1·20	2·40	trace.
Lime	18·06	14·21	17·59	2·18
Magnesia	0·80	1·14	2·50	0·10
Potash	5·64	2·21	2·00	0·60
Soda		1·10	1·70	0·07
Oxide of manganese	0·75	—	0·30	—
Oxide of iron and alumina	2·19	2·25	4·00	0·20
Soluble silica	1·00	0·45	0·44	0·94
Insoluble residue (sand, &c.)	8·00	6·00	9·06	1·12
	100·00	100·00	100·00	100·00
Nitrogen equal to ammonia	2·85	3·28	2·40	0·87

It has been found beneficial to increase the quantity of chlorine, and in the Urban cane manure of recent make it amounts to about twice the quantity indicated in these analyses. The above three bulks were supplied for soils partially exhausted of their mineral constituents, for new soils, in which these are abundant, the organic matter of the fœcal substances can be somewhat increased with advantage. I hope some day to be able to present a careful *immediate* analysis of this manure, but the accurate separation of all its organic ingredients is a task of great difficulty, and requires much time.

It will now be seen how absurd it is to apply to such products as these the usual commercial analysis of superphosphates (phosphoguano), which are valued solely according to the amount of soluble acid biphosphate of lime in their composition, whilst no such product is present in the Urban cane manure. Its phosphate of lime, except a small amount of bone meal, which I recommended to be added to produce porosity, consists of "precipitated phosphate," which is entirely assimilable, and is, in my opinion, infinitely preferable for canes, except on soils that are rich in lime.

It must not be imagined, however, that this Urban cane manure, nor any other, will dispense with a proper amount of tillage. We shall never possess a manure, as some of my correspondents appear to believe, that will enable us to dispense with labour altogether. This can never happen, at least not for canes or wheat, or any plants growing in stiff clay soils, for air is one of the most necessary ingredients in the soil, and the more air can be enclosed the quicker the manure will disappear, and the more efficacious will be its action in a given time. This remark applies especially to the stiff clays of Demerara. The benefit of labour in this respect will be seen in the following example:—Two samples of soils, one from British Guyana, the other from Barbadoes, gave me very nearly the same chemical composition, they had each been treated to the same amount of manure, but the Barbadoes soil gave the best crops. This was explained by inspection of the surface soil of both plantations; that of Barbadoes was comparatively light and porous, whilst the other was hard and stiff, in spite of its normal amount of organic matter.

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SUCRATES, AND THEIR APPLICATION TO THE EXTRACTION OF SUGAR FROM MOLASSES.

By M. E. Feltz.

[*Being a translation from the French of an Article written by request of the Council of the "Société Technique Russe," and read before a general Reunion of the Members of the Society, held at Goroditsch, on the 8th of Jan.*, 1872.]

The extraction of sugar from molasses has always occupied the attention of sugar chemists. Millions of pounds of crystallizable sugar are every year lost to consumption in this residue of our manufactories and refineries.

At first sight, nothing appears more simple than the solution of the problem which we have now proposed to study. Chemistry teaches us in fact that sugar may form with divers reagents some insoluble compounds, and the study of the sucrates of lead, of barytes, and of lime, forms part of the elementary course. The application of these contributions of science to the extraction of sugar might seem to be quite straightforward. Yet how unfruitful experiments with this aim have been since the first works of Dubrunfaut, Peligot, and Leplay.

Of all the sucrates known, the sucrate of baryta is the only one which up to the present time has been regularly used industrially.

It is to M. Dubrunfaut that the application of the process is owing. The sucrate of baryta, the composition of which was determined by M. Peligot, presents all the properties of a clearly defined compound, which may be obtained in the form of crystals. These properties which with regard to tho extraction of sugar are important qualities, distinguish the sucrate of baryta from the compounds more or less definite which sugar forms with lime.

M. Dubrunfaut applied the sucrate of baryta process in 1849, and at the present time it is still employed by Messrs. Tilloy & Bernard, at Courrieres, who by its use extract nearly 400 lbs. of sugar per diem from residual molasses.

Formerly sucrate of baryta was obtained by treating the molasses with sulphide of barium. To render the precipitation complete 1½ equivalents of sulphide of barium was required for one equivalent of sugar. To this mixture was added one equivalent of soda. There was thus formed some sulphide of sodium and some sucrate of baryta. On decomposing this latter by a current of sulphurous acid there are obtained sulphite of baryta and a sugar solution which will yield its sugar by the ordinary means. The sulphite of baryta properly washed and dried serves to reproduce the sulphide of barium.

At Courrieres the sucrate is obtained by the use of hydrate of baryta proceeding from calcination of a mixture of natural carbonate of baryta and carbon. Heated molasses is treated with a boiling solution of hydrate of baryta, care being taken to use an excess of baryta in proportion to the sugar contained in the molasses. The reaction is produced very easily and the precipitate washed with hot water produces after carbonatation a remarkably pure syrup, from which a suitable treatment with a mixture of sulphuric acid and sulphate of lime will remove every trace of baryta.

Dr. Stammer has published a complete treatise on the chemical part of this process, from which extracts will be made further on.

Experiments have been made with ordinary molasses having a coefficient of purity of 61 to 62. One pound of hot molasses treated with half-a-pound of hydrate of baryta served for the production of the sucrate. A small quantity of boiling water was added to this mixture which was then allowed to deposit. In decanting the precipitate was separated from the mother liquor, which was of the gravity of 30° Brix.

By adding two successive portions of boiling water to the deposit, there were obtained by successive decantations two washings marking respectively 15° and 8° Brix. On the first of these washings being mixed with the mother liquor the liquid obtained marked 17° Brix, after saturation and boiling it marked 14·5° Brix with a coefficient of purity of 22·6. 1040 cubic centimeters of this solution contained 45 grammes of sugar. The second washing was treated in the same way, and 1080 c. c. of a gravity of 6·6° Brix with a coefficient of purity of 49 contained 35 grammes of sugar.

Thus then by making these two washings there was a loss of 80 grammes of sugar, *i.e.*, 16 per cent. of the weight of the molasses, or 32 per cent. of the total quantity of sugar contained in the molasses, thus the yield from the sucrate could not by any means be more than 34 per cent. of the weight of the molasses.

The washings contained beside sugar and some impurities, nearly one-fifth of the whole quantity of baryta used, but suitable treatment by carbonic acid reduced this loss to 5 or 6 per cent.

The sucrate of baryta gave, after carbonatation, a syrup having a co-efficient of purity of 96·9. This figure speaks so eloquently that it is useless to descant on the qualities of such a syrup.

It is well known that baryta is poisonous; it was therefore very important to see whether it is really completely eliminated by the treatment to which the syrup is submitted before it is crystallized.

By adding to the syrup a little lime and some sulphuric acid, a deposit of sulphate of baryta is formed; and in syrups thus treated the least trace of baryta cannot be discovered, even by the most sensitive tests. The quantity of sulphate of lime which remains in solution at the end of the treatment does not exceed 0·2 per cent. of the weight of the sugar.

On filtering the solution through proper material the same result is arrived at. The loss of baryta due to this treatment is nearly one-tenth, which makes the total loss amount to nearly 7 per cent. of the quantity employed. Let us compare these results with Dr. Stammer's conclusions:—

"1.—It is easy by the use of sulphate of lime completely to precipitate the baryta even from strongly alkaline solutions. Thus, the sugar may be obtained from the sucrate of baryta in which there will not remain the least trace of baryta.

"2.—The sucrate obtained from the molasses is so pure, after simply washing, that the syrups proceeding from it give up the greater part of their sugar on crystallization.

"3.—The washing waters should be treated by carbonic acid if it is wished to avoid great loss of baryta, "4.—Notwithstanding every precaution the loss of baryta is so considerable as to affect the economical results of the process.

"5.—The loss of sugar is also very noticeble, and thus all the sugar contained in the molasses is far from being extracted."

M. Ahrens had the opportunity of visiting the establishments of Messrs. Tilloy and Bernard, in which nearly 1,500,000 lbs. of molasses are treated annually for the production of sugar or alcohol. Whilst admiring the grand effects produced in this immense establishment, the visitor was not disposed to imitation. The works appeared to him so colossal, the working so difficult, the manipulation of the caustic baryta so disagreeable, that M. Ahrens, although doing justice to the truly marvellous manner in which the establishment is conducted by Messrs. Tilloy and Bernard, confessed that the great difficulties deterred him from all desire of imitation.

Doubtless, considerations of this sort have prevented the more general application of the process. Sucrate of baryta appears to have been tried in Russia; the industrial and scientific value of the process is beyond question, but the difficulties of procuring baryta are too great, and the manipulations too disagreeable; in addition to the fact that it requires considerable capital, for the hope to be entertained of seeing the process extend in Russia.

If the extraction of sugar by the sucrate of baryta may be considered as perfectly resolved by M. Dubrunfaut's process, it is not the case with regard to the application of sucrate of lime to the solution of the same problem.

Numerous and persevering efforts have been made for thirty years past to replace the baryta, so difficult to obtain, by lime, which is so common and so generally used in the sugar manufacture. If sucrate of lime could be successfully used in the defecation of the juice, the cost of manufacture would be considerably diminished.

To understand the methods pursued by the numerous inventors who have endeavoured to solve this problem, it will be needful to glance at the principal properties of sucrates of lime.

We owe to M. Peligot the first careful researches into these sucrates, and into the general subject of the action of lime on saccharine solutions. This chemist recognises two definite combinations of lime and sugar. The monobasic sucrate containing 14 per cent., and the tribasic sucrate containing 33 per cent. of lime. The monobasic sucrate is formed whenever sugar, water and lime are brought together. This sucrate is soluble in sugar solutions, and the solution in its turn possesses the property of dissolving lime but never in sufficient quantity to form sucrate with two equivalents of lime. The tribasic sucrate is precipitated from solutions of neutral sucrate when raised nearly to the boiling point. This sucrate separated from the solution by filtration whilst hot becomes insoluble in hot water, and even in cold.

The more recent experiments of M. M. Boivin and Loiseau repeated and overlooked by a Commission whose proceedings were reported by M. Pelouze have proved that the sucrate which is formed in the cold by a mixture of lime and dissolved sugar is a bibasic sucrate. M. Dubrunfaut had already indicated in 1851 the conditions of temperature required for the formation of this compound. Sucrate of one equivalent was then unknown.

According to M.M. Boivin and Loiseau the addition of lime to sugar solutions will at first produce sucrate of 3 equivalents which dissolves in sweet water, the proportion of sugar never being fully combined. Tribasic sucrate is precipitated when the temperature is raised, or it becomes decomposed into bibasic when the temperature is lowered towards the freezing point.

M. Peligot observed that the proportions of lime dissolved by the sugar solutions varied with their density. M. Dubrunfaut on the other hand insisted on the fact which he mentioned in 1851 of the influence of temperature on the solubility of the lime. He had obtained by varying the temperature and the density, solutions containing from 1-4th of an equivalent of the base at boiling point, up to 2 equivalents at the freezing point. It is needless to remark that M. Dubrunfaut proportioned the lime dissolved to the total quantity of sugar in solution. More recent experiments have shown that there is always an excess of sugar uncombined.

When concentrated sugar solutions are saturated with lime, either a precipitation of an insoluble compound takes place, or the whole mass becomes gelatinous.

It was M. Peligot who discovered the first of these two reactions which has served as the base of many processes of extraction; the following is an extract from M. Peligot's observations:—

"When it is sought to saturate with lime a liquid containing 30 per cent. of sugar, the lime solution becomes at first very viscous, but solidifies into a mass at the end of a certain time. There may also be obtained at once a precipitation of sugar in the form of a calcareous compound, scarcely if at all soluble, by adding lime to a syrup marking 35° Baumé. In either case the product is mixed with an excess of lime which it appears impossible to separate."

Another property of limed sugar solutions noted by M. Dubrunfaut in 1851 has been the subject of a patent for some years for the extraction of sugar: it is this—"monobasic sucrate of lime treated by carbonic acid only becomes turbid when the solution contains one third of an equivalent of carbonate of lime for one equivalent of sugar. In this case the sugar still retains two-thirds of the equivalent of lime. By continuing the carbonic reaction, the liquor continues to get more turbid until at a certain time it becomes a stiff gelatinous mass."

Alcohol produces on limed sugar solutions some reactions which have been carefully noted by M.M. Boivin and Loiseau. These gentlemen have proved that all calcareous sugar solutions when treated by alcohol invariably yield a precipitate containing 24·6 per cent. of lime. This precipitate may be washed with alcohol sufficiently weak not to precipitate the sugar, or it may be washed with cold distilled water free from carbonic acid. The washings are tedious and need great care to remove all the free sugar.

This difficulty of extracting the free sugar from the sucrates, on which M.M. Boivin and Loiseau insist, and with reason, becomes almost insurmountable, when instead of solutions of pure sugar impure syrups are used. It is not then merely a question of extracting the free sugar, but also of separating the impurities of the mother liquor obtained from the sucrate. This is the stumbling block in the way of the success of every process hitherto discovered grounded on the formation of sucrates of lime.

The most remarkable property of calcareous sugar solutions is without doubt that of precipitating an insoluble sucrate by boiling. Thus the first efforts of chemists were directed to the application of this reaction to the extraction of sugar. Messrs. Dubrunfaut and Leplay patented this reaction in 1849. M. Peligot also in his memoir presented to the Academy of Sciences, 3 May, 1851, also speaks of his efforts in this direction:—"I have been able," said he, "to obtain from raw beet sugar molasses 25 per cent. of crystallizable sugar by the sole agency of lime, carbonic or sulphuric acid. Obtained by separating the basic sucrate of the liquid by boiling, and by saturating this liquid with a fresh quantity of lime several times after cooling, the quantity of sugar is less than that extracted by M. Dubrunfaut from the same residues, by precipitating in a single operation the sugar in the form of sucrate of baryta; but the low price of lime, its harmless nature, and many other circumstances, give nevertheless some interest to my experiments."

Whatever the mode of industrial operation recommended by M. Peligot, the efforts of this *savant* do not appear to have been more successful than those of Messrs. Dubrunfaut and Leplay.

The former thus speaks of the results of his studies on this subject.

The natural and praiseworthy desire to substitute lime for baryta has led us to make many researches and efforts towards this end, since we made known in 1849 with M. Leplay the system of working sugar by means of sucrate, and we seriously believed up to 1851 that we had found in the tribasic sucrate, discovered by M. Peligot in 1838, a base for the operations of manufacture for the solution of this important problem. It came to nothing, and we have already declared that we were mistaken in looking in this direction, and we have explained the causes of our error. We have in fact proved that though with pure sugar we may be able to prepare in appearance a basic sucrate of lime, from which we are able to extract the sugar by means of acids this process applied to impure syrups, like molasses, will not result in the formation of a pure defined sucrate, from which pure sugar may be obtained.

(To be continued.)

THE SUGAR INDUSTRY IN NEW SOUTH WALES.

One strong beam of hope shines from the northern rivers. The sugar industry there is assuming great and permanent proportions. It has passed through a critical stage and is emerging with honours. In the first instance, it seemed necessary to exaggerate the expectations formed of the sugar cane in order to get anyone to try it, and since it was planted until the present year the conditions for testing its worth have been absent; for, when the season was good, the necessary machinery was absent; and when the machinery arrived the season was adverse. Although a strong opinion, based on physical considerations, was expressed from the first concerning the suitability of the crop to this colony, gross ignorance prevailed respecting the treatment of the cane and the manipulation of the juice. Experience had to be purchased at considerable cost, for many of those who first ventured to make make sugar utterly failed in the attempt, and have been obliged to retire from the field. These failures, and the miserable weather that prevailed during the sugar-making season last year and the year previous, induced many men, not only to abstain from planting more cane, but to determine to plough up what they had. A favourable winter and a genial spring have happily operated to stop this process. The cane is taken into favour again. Planting is going on anew. The abandoned mills are again at work, and confidence is restored. The planters and manufacturers are beginning to understand what they are doing, and what they have to expect, and they find the reward promised, fully equal to the toil and expenditure required. The experience of the last year or two has thrown a good deal of light upon the worth of the several sorts of cane, some being of little value and some of special adaptation to particular circumstances. The planters are acquiring knowledge of the soils best suited to the several varieties of cane and the treatment needed to bring out their virtues. They are also finding out when it is best to plant and when to cut. At first mistakes were made in these matters that will henceforth be avoided. It is hoped, too, that the want of harmony between the sugar-makers and the growers, which was the result of misunderstanding and misinformation on the part of the latter, may be no longer observable. They now see the bulk that can be grown and what it costs to grow it, and are able to compare the results of growing cane with the results of growing maize. It is generally admitted that an ordinary crop of cane pays far better than an extraordinary crop of maize. On this point we quote from the letter of our special reporter to the Clarence. He inserts the evidence given by the lessee of one of the sugar mills:—"In reply to queries about cane and corn, I would say that I am this season paying from £15 to £16 10s. for good full crops of cane per acre, such acres yielding from 35 to 45 tons. I am paying 15s. per ton for cane delivered at the mill. Cane delivered on the river bank at a distance from the mill is worth about 12s. per ton. The cost of cultivating an acre of cane, is £6 to £8 the first year, and £5 for ratoon crops. The cost of cultivating an acre of maize, including thrashing, &c., is about half the above. The average yield of cane per acre is about 35 tons. The average yield of dry sugar per acre about 2 tons. The price of sugar at the mill about £32 per ton."

It was considered that New South Wales had no chance as a sugar producer against Queensland. But it does not seem to be so. The yields this season are reported to excel those of the Queensland growers. The cane crop of last season on the Clarence did not cover more than 446 acres—the amount of sugar sold and consumed is set down at 1,072 tons, so that the produce per acre must have been about 2½ tons. In Queensland, however, they have overtaken their own consumption; we, on the other hand, must multiply our present product by thirteen before we reach a like point.—*Sydney Morning Herald.*

BRITISH REFINERS AND THE FRENCH DRAWBACKS.

The increase of the French sugar duties, which will add materially to the bounty obtained by the Parisian refiners on the export of loaf sugar, appears to have alarmed refiners on this side the channel and led them to consider the probable increase in the difficulties of their position. Refining proper, that is, the making of loaf sugar, has been almost extinguished in this country by the competition of the French and Dutch. The successive reductions in the sugar duties in this country have been followed by greatly increased imports of loaf sugar relatively to the imports of raw.

The practice of giving open or disguised bounties on the export of loaf sugar, part of the system of protecting native industry, is of long standing in several continental countries, and to put an end to this practice was the object of the sugar Convention of 1864. A contemporary asserts that the Convention has utterly failed to accomplish the end intended "through the ignorance of the subject shown by the negotiators and their complete neglect in omitting to consult practical or scientific persons on the question." Now supposing that the Convention has failed in its object, it is not for the reasons given, inasmuch as the parties interested were consulted before, and during the progress of the negotiations, whilst practical refiners from all the four countries were engaged in superintending the Cologne experiments, by which the relations between duties and drawbacks have been regulated ever since. Had the Convention never been entered into, it is quite possible that the position of the British refiner might have been even worse than at present, inasmuch as protection to our native industry was even then a thing of the past, whilst it has continued to exist up to the present in all the other countries parties to the Convention. In reality the increased import of French loaves has not been in consequence of the Convention, but in spite of it, as will be seen from the fact that after a considerable reduction in the sugar duties of this country in 1864, the import of loaf sugar increased nearly threefold in the same year, though the Convention was not ratified until the year following. The yields obtained by the Cologne experiments fairly represented the state to which refining had then attained in Europe, and if there had been no improvement in the process, no change in the proportions of sugar used, and if the provisions of the Convention had been fairly carried out, there is no doubt but that its object would have been attained, by the refiners of all the four countries being placed as nearly as possible on an equality.

The assessment of the duties on raw sugars according to their saccharine value with drawbacks on refined exactly to correspond is unquestionably the most equitable in principle, and if it could be carried out in its integrity would leave nothing to be desired. The assessment by colour and apparent value, is of course only an approximation to this, but that it is an approximation, on colonial sugar at least, will not be denied. The Cologne experiments were made on mixtures of sugars of various kinds, chosen by colour and appearance to represent the different standards; some of these mixtures were entirely composed of colonial sugars, and all of them chiefly so, the proportions of the various kinds used in refining in the four countries being carefully preserved. Since that time the proportion of beet sugars used, especially in France has very largely increased, and as is well known the relation between colour and saccharine value is not nearly so close in beet as in colonial sugars; buying by analysis is also universal, so that French refiners are able to obtain much greater returns than those of the Cologne yields. Besides it must not be forgotten that the process of refining has been greatly improved, and although this may be said to apply to refiners on both sides of the Channel, the greater advantage is with those where the duty is the highest, when the yield is in excess of the fixed standard. Thus as was pointed out in a former number of this magazine, none of the conditions under which the Convention was entered into remain the same. Further, it is well known that the Convention has never been fairly carried out in France where its provisions are always interpreted in favour of the refiner.

The advantages which are now confessedly enjoyed by the French refiner will by the increase of 50 per cent. in the duties be greatly augmented. The value of the four months credit, and of the overplus of yield beyond the Cologne standards, will thus be increased by 50 per cent. We believe that these considerations have induced British refiners to take action in the matter. The initiative seems to have been taken by the Greenock refiners who are not makers of lump, and who therefore have not yet felt the direct competition of the Parisian refiners, who rarely make anything but fine loaves and low molasses. Probably the time when French refiners will not only be able to supply the entire English consumption of loaf sugar, but will see it to their interest to become makers of pieces and crushed as well, has been foreseen by the refiners of the North, who have thus characteristically taken time by the forelock—remembering the adage, that "prevention is better than cure."

It is reported that a deputation of refiners waited upon Mr. Gladstone and Mr. Lowe last week, and that four of their number have gone to Paris to confer with the "Committee of *Fabricants*" there, whose interests are by no means identical with those of the refiners of their own country.

What course is advocated by British refiners with regard to the duties and to the Convention has not transpired beyond their own circle. It is said that refining in bond forms part of their programme, whether with a single duty or a scale does not appear. Refining in bond if adopted by all the countries parties to the Convention,—the duties being assessed only on sugars when taken for home consumption in the respective countries,—would redress the principal evil of which British refiners complain. There would be an end of all drawbacks, and of all the bounties and inequalities connected with them, and no country would have a right to interfere with the system of assessment carried out by any of the others. The expenses entailed by refining in bond would only be transferred from the present Custom Houses, where the labour and trouble would be greatly reduced. There would doubtless be difficulties in the way of a scale of duties, and a uniform duty would be more favourable to the refiner who turned out fine goods than to the pieces maker. But there would be no difficulty in making a difference between the duty on loaf, and that on crushed; and the imposition of a low duty on syrup of a certain poverty would to some extent redress any inequality which might press on the workers of low sugars.

The duties on imported sugars raw and refined, and on syrup going directly into consumption would of course be the same as on those leaving the refineries. Thus one duty being paid on loaf, one on all other refined or raw sugars, and one on all syrups of a certain poverty easily ascertained, there would be no sampling of sugars in the Custom Houses, nor comparing of colour. In the refineries the duty might be calculated and paid when the sugar was packed and left the refinery proper for the warehouse, or the product might be bonded. Whatever the difficulties attendant on this system, the expenses of collecting the duties would not necessarily be greater, and might even be less than at present. Illicit refining being next to an impossibility there would not be much danger of the revenue being defrauded, especially with low duties.

As a remedy for the evils under which our refiners are suffering, Mr. J. B. Smith, M.P., and *The Produce Markets Review*, which objects to refining in bond, have only to propose a fixed duty on sugars and syrups of all grades and conditions of purity, with one drawback of the same amount; and this they call free trade. They lose sight of the fact that it would be a *direct* bounty to the foreign refiner of the proportion of the duty corresponding to the difference in the weight between the raw sugar taken into the refinery and the loaf sugar turned out; even on *fine* beet sugars the loss is placed by M. Dubrunfaut at an average of 10 per cent.; and in the case of refining qualities of British West India the difference would probably be nearer 20 per cent. against the English refiner: this would be in addition to any advantage the foreign refiner might receive indirectly from his own Government. There is not much danger of this proposal being carried out, Mr. Lowe not having learnt the principles of free trade from Mr. J. B. Smith, M.P., but rather holding those of Mr. Cobden, whose lessons Mr. Smith seems to have forgotten.

SUGAR CULTIVATION IN NATAL.

Agriculturally the proofs of progress are confined almost entirely to the coastlands. In the midlands and upper districts there has been marked retrogression, owing to the causes just named. Large breadths of land have during the year gone out of cultivation in those districts. On the coast, however, planting goes on apace. Sugar, coffee, and cotton take up more and more of the soil. Only one new mill has been erected—the splendid fabric on the Umgeni Sugar Company's estate, but as that is the second erected on one of our oldest plantations, it indicates merely an expansion of an existing enterprise, not the creation of a new one. Many improvements have been effected, however, in old mills. New machinery, and in some cases new mill houses have been put up. The vacuum pans at Redcliffe and Ottawa, are in full operation, and the sugar produced on all estates where this great adjunct is employed, will compare favourably with any sample from Mauritius. At Sunderland, the concretor has continued in active and successful operation, and many persons hold here—as we see elsewhere—that a combination of both systems—the concretor and vacuum pan—conjoined with the central factory system—would represent the perfection of economy in sugar making. There is more and more a disposition to divide the two functions of cane-growing and sugar-making—of the cultivator and the mill owner—and round several estates already, small planters are growing patches of cane to crush at the neighbouring mill. In some cases land is being leased only, so that the planter has to bear the first cost, neither of soil nor of machinery, and thus reduces his outlay to a minimum. Difficulties of transport alone prevent the expansion of this system. While oxen are so scarce and so liable to sickness as at present, the cost of carrying cane more than a certain distance would prove a bar to its profitable growth. It is possible that some of the many proposals that have been put forward to apply the wire rope system may meet this difficulty. Already on hilly estates wire shoots are in general use, and effect considerable economy in working expenses. Should, as is more than probable, railways be carried out, the relief of oxen now employed along the main road, will set free large supplies for plantation service.

It is strange that so little foreign enterprise embarks in sugar planting here, or rather it would be had not so many failures been experienced during the earlier years of the industry. These failures, however, were the necessary consequence of inexperience and ignorance. Things are altered now. A generation of young planters has risen to maturity, and the losses of the past have taught their lessons and left their fruits. When the stream of coolie immigration comes again to set regularly this way, and when railways provide adequate means of transport for the produce of plantations, the attention of planters and capitalists in other countries will probably be directed to a country where sugar can be grown under conditions so advantageous.

Prices of Sugar, &c.—The weather during the past month has been most favourable for planting operations, there having been fine and frequent rains. On all estates the hands are now as busy as they can be. The advices received from Mauritius that there would be a deficiency in the crop there this season, have caused holders of lots here to endeavour to establish an advance in prices—an effort in which they have been to some extent successful, having established an advance on all descriptions of from 1s. to 1s. 6d. After the heavy rains, a little dry weather would now be acceptable, that crushing operations might proceed. We quote the rates as follow:—

White crystals (vacuum pan), 1st quality	28/6 @ 30/0	⅌ cwt.
White crystals, do. 2nd quality	27/0 @ 28/0	,,
White crystals (wetzel pan)	23/6 @ 24/0	,,
Light yellow crystal	22/6 @ 23/6	,,
Light yellow counters	21/0 @ 22/0	,,
Yellow ordinary	19/6 @ 20/6	,,
Grey, dry and grainy	18/6 @ 19/0	,,
Syrups, yellow	17/6 @ 18/6	,,
Do. dark yellow and brown	17/0 @ 17/6	,,
Do. low brown	15/6 @ 16/6	,,

Natal Mercury.

PROGRESS OF THE BEET SUGAR MANUFACTURE IN FRANCE.

The manufacture is nearly finished, especially in *le Nord* and in the *Pas-de-Calais;* yet there are a number of factories which will continue to work a few days longer. The return has not been satisfactory in these two departments, where as a general rule the yield in sugar has not been over 5 per cent. [of the weight of beet]. In *la Somme*, *l'Aisne*, *l'Oise*, and some other departments, the working will continue for some time longer; and in many *usines*, some of importance will not have finished before the 15th or the 20th of February. Certain factories lately started or largely supplied with beet roots, will continue at work up to and into March.

The return of the beet roots in these departments is higher than in *le Nord* and the *Pas-de-Calais*, and shows in certain districts some exceptional results. Many factories will have obtained 5½, 5¾, and even 6 per cent. and above. This will compensate for the poverty of the beet in saccharine in some other departments.

All things considered it may be presumed that the production of the season will be between 310 and 320 millions of kilogrammes (310 to 320 thousand tons).—*Journal des Fabricants de Sucre.*

SUGAR REFINING IN GREENOCK.

This staple branch of industry has been steadily brisk during the year, and the extensions and improvements effected in many of the refineries have increased the working capacity. On an average about 4,200 tons per week have been turned out, which makes the year's quantity nearly 220,000 tons. The stock of raw sugar in bond in the port at present is about equal to that of last year. We subjoin statements as to the work of the majority of firms:—

Crawhall, Allison & Co.

This firm have been for some time past engaged in making extensive additions to their premises in Dellingburn Street. During the year, the properties in which are placed the Eagle Tavern and the east-end branch of the Clydesdale Bank have been acquired, by which the area of the firm's ground is now of great extent. The additions in course of progress include a large new store, improvements in the refinery, charcoal house, &c., and several months will elapse before these alterations are perfected. In consequence of these improvements, the turn-out of sugar during the latter portion of the year has not been so large, but an average of 200 tons per week, during the entire year, is a near approximation. When the additions are made, Messrs. Crawhall, Allison, & Co. will be in a position to turn out from 400 to 500 tons of refined sugar each week.

Alexander Scott & Son.

Messrs. Scott have had an immense share of work during the year, the turn-out being no less than 430 tons of refined sugar per week. A new refinery is in course of construction for this firm in Drumfochar Road, an the site of Messrs. Anderson, Orr, & Co.'s sugar-house, and when this additional house is completed, the immense quantity of over 1,000 tons per week will be turned out out by the firm. The erection of the new refinery is now finished, and the machinery is being constructed and fitted up with all despatch. Some months will, however, elapse ere the work for which the house is erected will be commenced.

CARTSBURN REFINERY.

In the middle of the year 1870 the Cartsburn Refinery changed hands, and the new firm having in the interval altered and improved the house in point of machinery, &c., operations were recommenced in December following, and 200 tons of sugar were refined per week for some time. It was found, however, advisable by the Company to limit the working capacity to 160 tons per week, and on an average that quantity was turned out during the year.

PAUL, SWORD, & CO.

This firm have during the past year built a store for their own use capable of containing about 1800 hhds. of sugar, and they have made a number of important changes in the interior of the refinery. The turn-out was at the rate of 250 tons per week.

PATTENS & CO.

The year just closing has been the most prosperous of this firm, who have during the season been turning out 300 tons of refined sugar per week.

GLEBE REFINING CO.

During the entire year this refinery has been working to the full, and turning out 700 tons a week.

JOHN WALKER & CO.

The immense quantity of 41,529 tons of refined sugar was turned out by this firm during the year. A large addition to the store is at present being made.

D. & J. GIBB.

This firm extended their char-house during the year, and turned out 150 tons per week. They purpose shortly adding to their machinery so as to give greater facilities for working.

ALEX. ANDERSON & SONS.

The refinery of the above firm was enlarged during the year by a flat being added to it, and a large store is at present in course of erection at the east end of the house.

D. & T. RICHARDSON.

During the past year, Messrs. Richardson demolished the old sugar-house in Roxburgh Street, and for months back workmen have been engaged in erecting on its site a large refinery and stores. These erections will not, it is computed, be finished till towards the end of next year, but when this is done, and the machinery started, upwards of 600 tons of refined sugar will be turned out each week.—*Greenock Paper*.

PRICE OF SUGAR AT THE DIAMOND FIELDS.—Large numbers of parties have arrived from Natal during the past week, and those who have brought up sugar in pockets have made a splendid freight. It has been all sold readily on the morning market at 8d. per lb., and even supposing the sugar cost 28/0 per cwt. (for it was of excellent quality), your readers can make their own estimate of the return. One pocket of 70 lbs. white crystallized fetched 1/6 per lb., whereas it can be bought at the stores at 1/0.—*Natal Mercury*.

A settler in New Caledonia communicates to the *Australian* as follows:—

Sugar cane is indigenous to the island; small patches of it are to be found near every native village; there being no frost, as in Queensland, to check its growth, it attains to a great size. The natives have many varieties of cane—the dark red, the white, the yellow, brown and ribbon canes. Native canes are much prized as plants, and can be obtained for pipes and tobacco. The settlers having a supply of plants always at hand, it only needed the erection of sugar mills to encourage them to plant. These are now being built in several places. A bonus of 500 hectares of land (2,250 acres) was offered to the proprietors of the first and second crushing plants. Mr. Joubert of Kue. on the Big River, was the first claimant. The Catholic Mission at St. Louis imported the second mill; but as the Fathers did not claim the award, it was given to Mr. Duboiset, whose plantation adjoins that of Kue on the Big River. The Mission at Paita also possesses a mill, and undertakes to crush cane for the settlers. The Tamoa Sugar Company's mill is expected shortly, the colonists on that river having already begun planting. A Bourbon planter is erecting a mill and forming a plantation at Bouloupari; and at Bourail a mill is to be erected, a supply of cane being guaranteed by the Government from the plantations worked by the freed convicts. Thus efforts are being made to encourage the growth of cane in the colony. . . . . A grant of 500 hectares is allowed to any one possessing the means to utilise the same. A hectare is 2¼ acres English. The colonist is permitted to rent the land for five years, with pre-emptive right, at 1½fr. the hectare, say 6½d. per acre. At expiration of the term he is supposed to be able to purchase. Convict labour is available. A man is paid £4 8s. 4d. upon hiring. The men get 12fr. per month, the boys 6fr.

NOTICES OF BOOKS, &c.

"*Digest of the Report of the Commissioners of Enquiry into the condition and treatment of immigrants in British Guiana.*"

This pamphlet is one of great value and interest as well to those who look at the question of Coolie emigration from politico-economical or from philanthropical standpoints, as to all interested in the sugar industry, and in the prosperity of our sugar-producing colonies, and of British Guiana in particular.

The Commissioners were, as is well known appointed by the Home Government to enquire into the serious charges which had been preferred by Mr. Des Vaux against the planters, magistrates, emigration agents, and others, of British Guiana,

The manner in which the Commissioners pursued their enquiries appears to have been the very best that could have been chosen, and their report is distinguished for clearness and precision in all its parts, and has nothing of the "dry-as-dust" character, generally attributed to legal or official reports.

Besides the examination on oath of Mr. Des Vaux and forty-six witnesses, amongst whom were Government officials, emigration agents, magistrates, doctors, lawyers, planters, merchants, labourers, and others, the Commissioners personally visited many of the plantations employing immigrant labour, wisely concluding that the interminable task of hearing judicially all the coolies in the colony who had any complaint to make would be much less likely to elicit the real truth than hearing what they had to say in a less public manner. As the report says, page 3 :—

"We preferred to go upon the estates ourselves, and watch the every day relations between the labourers and their employers. We desired to hear from the managers the statements of their difficulties, and to be shown what they had done and were doing for the welfare of their people. We wished to hear what the Immigrants had to say without bringing them into a position where they would not have ventured except in rare cases to speak with freedom; and we found it possible to arrive with far more confidence at the truth which lay at the bottom of conflicting statements, where we could submit them, to a certain extent to the test of our immediate personal observations. We desire therefore that our report may be considered as founded in part upon the evidence which we have thus qualified ourselves to give."

"We visited and carefully inspected 55 out of the 124 estates now employing immigrant labour, and cultivated with scarcely an exception as sugar plantations. On each occasion we examined the dwellings of the immigrants. the hospital, and the pay lists and other business books of the estate, as well as the register which is kept upon each plantation for the information of the immigration office. We also as occasion might serve, observed many other subjects of interest, such as the water supply, the schools, the gardens, cattle and property owned by immigrants; and without ever expressly inviting complaints, we gave a full hearing to every one that was made to us, and investigated, so far as we could all those which seemed to deserve investigation. * *

"In order to ensure the confidence of the immigrants in our impartiality, as well as to remove the temptation to prepare things for our inspection, we deemed it necessary to make most of these visits without concert with, or notice to, the employer; but we were accompanied in our inspection by the manager or other person in authority and we have recorded no complaint against the management upon the testimony of the people, without inviting explanation from the estate officer who was present."

"If it be remembered that all the manifold information we have sought for and received from the planters has been in fact given behind the backs of the labourers who have no means of knowing what was said of them or against them, it will not be thought improper but plainly equitable that we should have taken frequent opportunities of conversing with the labourers apart from the overawing presence of their employers."

In this mode of enquiry the Commissioners record that they received every assistance from the estate proprietors or overseers, and with regard to the estates not visited every facility was given to the immigrants thereon to state their grievances, by the stay of the Commissioners for several days within a day's journey of such estates.

In the course of their enquiries the Commissioners also read an immense mass of papers supplied from the Government offices, including the records of the immigration office for the last ten years, voluminous correspondence and accounts of law proceedings connected with complaints of immigrants for the preceding six years, and every other record which might prove of service to them in the task they had undertaken, besides much information forwarded from private sources, and a quantity of rough notes of the complaints of immigrants in a very imperfect condition, which were transmitted to the Commissioners by Mr. Jenkins.

So much for the manner in which the enquiry was prosecuted, respecting which it may be said that if all Commissions were conducted so unexceptionally, public opinion of the value of Government enquiries would stand far higher than it does at present.

The verdict of the Commissioners on the charges made by Mr. Des Vaux was given in a former number of *The Sugar Cane.* The planters and others concerned have reason to be satisfied with this part of the report, after such a searching and impartial investigation. It was not to be expected that either the system should be proved to be perfect or that no individual cases of oppression should be found to exist, but it is much that Commissioners were able to say that Mr. Des Vaux "was ill advised in bringing a series of charges so vague, so sweeping, and so little admitting of satisfactory proof."

The following extract from the account of the colony, given by the Commissioners on page 9, will be satisfactory to the political economist, though some parts of it may be read with regret by the lovers of the patriarchal and the picturesque :—

> "Perhaps 40 out of the 85 estates owned entirely out of the colony are in the hands of merchants; and these include nearly all the largest, finest, and best-cultivated of the whole. The resident proprietors have all purchased not inherited their estates. The aspect and future of the tenure of land throughout the colony is not territorial, aristocratic, patriarchal, or feudal, but simply and exclusively commercial. Whatever elements of natural or artificial beauty, whatever traces of refined leisure, may formerly have surrounded the planter's home have vanished; even the tropical luxury for which it was once so famous, has to a great extent disappeared, and in its place utility, economy and the latest appliances of scientific farming and manufacture now constitute the chief features of the thriving sugar estate."

The practical results of this change are seen in the statistics of the exports from the colony, which prove how advanced are the processes of manufacture now in use, compared with those of twenty years ago.

> "The exports of the colony for the year ending 31st December, 1870, were 94,944 hogsheads of sugar, 20,716 puncheons of rum, 17,606 casks of molasses, 153,127 cubic feet of timber, 103 bales of cotton, 6,221,225 shingles, 28,062 cocoa nuts,—by far the largest produce ever shipped from this colony."
>
> "We find the sugar crop of 1849 set down at 38,000 hogsheads of sugar, the average weight of a hogshead of sugar being at that time about 1,600 lbs. Nearly all, if not the whole, of this sugar was Muscovado, while in 1870 fully two-thirds of the crop was vacuum-pan sugar, and therefore of greater value. The 38,000 hogsheads of that day would be equal to 33,778 hogsheads of the present dimensions—that is of 1,800 lbs. Therefore the sugar crop has in 20 years nearly trebled in value."

Several other chapters of the report besides those briefly adverted to, are well worthy of notice, and would supply numerous extracts of great interest, containing, as they do, many important facts and valuable suggestions; but the coolie question in British Guiana has already been twice brought before the readers of this magazine recently.

IMPORTS, EXPORTS, CONSUMPTION AND STOCKS OF SUGAR IN THE UNITED STATES OF AMERICA,

(ATLANTIC COAST,) FOR TEN YEARS, FROM 1862 TO 1871.

(From H. E. Moring & Co.'s Supplement to Monthly Sugar Circular.)

IMPORTS OF FOREIGN SUGAR AT NEW YORK.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	Average 10 years.
	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.
From Cuba	133,923	138,317	124,748	197,577	184,118	173,942	206,952	219,713	188,125	196,624	176,404
,, Melado	....	....	....	....	....	224	534	3,860	9,042	19,092	3,275
Porto Rico	15,808	9,646	6,420	15,926	20,394	16,481	20,140	18,973	20,092	21,386	16,527
St. Croix..........	734	337	28	178	2,054	1,873	2,254	1,551	1,931	4,032	1,497
Brazil	3,856	4,671	1,796	3,622	5,178	1,638	3,778	10,180	4,406	5,589	4,472
Manila	4,139	3,119	5,001	4,460	3,695	3,129	8,886	14,589	13,523	17,271	7,781
Singapore, Java, China, &c.	92	98	424	184	2,917	761	218	874	668	3,966	1,020
Barbadoes, Demerara, Jamaica, Trinidad, and other English Islands, Martinique, St. Domingo and other West India Ports and Islands	5,087	6,595	1,662	6,929	8,836	5,318	16,100	21,588	14,729	42,548	12,939
European and other Foreign Ports	3,281	1,422	368	715	2,212	276	211	1,007	1,118	3,101	1,371
Total Imports at New York	166,920	164,205	140,447	229,591	229,404	203,642	259,073	292,335	253,634	313,609	225,286

These figures have been made up by the New York Price Current, according to actual returns of weight.

TOTAL IMPORTS OF FOREIGN SUGAR.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.
	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.
At New York	166,920	164,205	140,447	229,591	229,404	203,642	259,073	292,335	253,634	313,609
Boston	28,366	28,370	28,135	39,298	53,542	40,886	62,237	57,786	64,024	81,679
Philadelphia	29,741	27,670	24,140	40,210	52,620	50,658	66,121	56,704	50,571	55,918
Baltimore	16,658	16,562	14,401	27,655	38,182	35,241	53,458	57,213	67,303	84,675
New Orleans	....	214	726	14,469	19,523	16,094	19,706	21,530	12,628	13,331
Other ports....................	5,330	6,116	7,570	11,020	10,226	9,280	10,380	15,786	20,797	13,885
Total imports of foreign sugar......	247,015	243,137	215,419	362,243	403,497	355,801	470,975	501,354	468,957	563,097
Domestic crops of 1861-1862, &c....	235,858	56,000	28,000	5,000	8,500	22,500	23,000	45,000	46,800	79,600
Total supply of foreign and domestic sugar	482,873	299,137	243,419	367,243	411,997	378,301	493,975	546,354	515,757	642,697
Consumption of foreign sugar	241,411	231,308	193,980	345,809	383,178	378,068	446,533	447,899	483,892	553,714
,, domestic ,, ...	191,000	53,000	28,000	5,000	8,500	22,500	23,000	45,000	46,800	79,600
Total consumption of foreign and domestic sugar	432,411	284,308	221,980	350,809	391,678	400,568	469,533	492,899	530,692	633,314
Exports	9,774	5,397	20,920	3,551	7,444	6,231	8,246	13,793	9,029	5,047
Stock of foreign sugar at all ports, Dec. 31	21,735	27,967	28,486	41,369	54,244	25,746	41,942	81,604	57,640	61,976

Consumption of Cane Sugar, Atlantic Coast .... 633,314 tons, against 530,692 tons in 1870, and 492,899 tons in 1869.
,, ,, Pacific Coast ...... 22,000 ,, ,, 21,000 ,, ,, ,, 24,500 ,, ,,
,, Sugar made from molasses .... 25,000 ,, ,, 31,800 ,, ,, ,, 33,000 ,, ,,
,, Maple Sugar .... 17,000 ,, ,, 23,000 ,, ,, ,, 24,000 ,, ,,

Total Consumption.............. 697,314 tons, against 606,492 tons in 1870, and 574,399 tons in 1869.

The consumption in 1871 shows an increase of 90,822 tons, or 15 per cent. as compared with 1870, or an increase of 122,915 tons, or $21\frac{2}{3}$ per cent. compared with 1869.

Correspondence.

LONDON, FEB. 10, 1872.

TO THE EDITOR OF "THE SUGAR CANE."

SIR,

The letter from Mr. Gill in your last number, on the drainage of sugar, during the voyage to England, calls for some remark, especially that part of it relating to Demerara, which colony, by the way, Mr. Gill (inadvertently no doubt) speaks of as an island. That is not of much consequence and merely repeats the mistake, which in a former number of *The Sugar Cane* we are told on the authority of Mr. Jenkins was commonly made by two eminent legislators of the last generation; but what is more important is that Mr. Gill's statistics are somewhat loosely compiled. It is quite possible that some hhds of Demerara and Barbadoes sugar may weigh a ton nett when shipped, some authorities give the average weight of Demerara hhds as about 16 cwt.; but to calculate an actual loss it is needful to have the actual and exact weights both on shipment and arrival, otherwise the calculations of loss are only assumed. Mr. Gill's conclusions are at all events very unjust to Demerara. Whatever might have been the case in 1867, in no part of the world is the sugar manufacture now carried on more scientifically or successfully. All parts of the manufacture are well conducted, the defecation of the juice is carefully attended to, and on a majority of the estates vacuum pans and centrifugals are used—in 1870 two-thirds of the crop was vacuum pan sugar, the drainage upon which on the voyage could only be of a very trifling character. It may be added that Demerara crystals though manufactured without animal charcoal are worth nearly the same price as common loaf sugar in the London market. With regard to Barbadoes I think it will be found that Mr. Gill's estimate of the average weight on shipment, of hhds. from that island is too high, consequently the "annual loss" assumed is much greater than the reality.

I am, Sir,

Yours &c.,

V.

HAVANNA AND MATANZAS.

Exports from the 1st of January to the 31st of December.

(From Licht's Monthly Circular.)

	1871. Tons.	1870. Tons.	1869. Tons.
To United States of America	195,960	195,655	200,330
,, Great Britain	68,301	176,382	167,061
,, Spain	45,827	59,789	47,389
,, France	12,600	44,454	49,106
,, Northern Europe	8,915	11,360	10,423
,, Southern Europe	634	3,410	3,208
,, Other Countries	3,922	8,296	6,325
Total	336,159	499,346	483,842
Stocks in Havanna and Matanzas	8,700	4,498	27,325

MAURITIUS.

(*From Licht's Monthly Circular.*)

Exports from 1st August to 12th December,

	1871. Tons.	1870. Tons.	1869. Tons.
To England	21,207	8,319	18,572
,, France	12,592	3,566	5,431
,, Australia	12,649	16,168	16,924
,, New Zealand	1,987	1,717	3,123
,, Bombay	19,546	11,430	17,270
Cape of Good Hope	397	1,261	776
,, Other Countries	1,269	187	589
Total	69,647	42,648	62,685

Estimated Production of Beet-root Sugar on the Continent of Europe compared with that of two previous seasons.

(From Licht's Monthly Circular.)

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
France	315,000	289,093	289,324
Germany (Zollverein)	195,000	262,986	217,192
Austro-Hungary	160,000	182,280	151,353
Russia and Poland	90,000	135,000	132,500
Belgium	55,000	55,739	43,552
Holland and other countries	25,000	17,500	12,500
Total	840,000	942,588	846,421

Note.—Though the total of this season's estimate remains the same as last month, the figures assigned to three of the countries have been altered.

Stocks of Sugar in the Chief Markets of the World on the 1st January, in thousands of tons, to the nearest thousand.

	1871.	1870.	1869.
United Kingdom	103	119	122
France	87	129	128
Germany (Zollverein)	38	42	42
Holland	25	13	13
Six other depôts	5	4	4
	254	306	309
United States	63	56	81
Havanna & Matanzas	9	4	27
Total	326	366	417

Consumption of Sugar in Europe and the United States, for the Years ending 30th December, in thousands of tons.

	1871.	1870.	1869.
United Kingdom	687	668	623
France	340	316	321
Germany (Zollverein)	220	223	225
Holland	21	31	26
Six other Countries	117	95	109
	1,385	1,334	1,303
United States (Imported)	540	466	429
Total	1,925	1,800	1,732

SUGAR STATISTICS—GREAT BRITAIN.

To 17th February, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	6	2	1	4	13	17	5	1	1	3	10	12	10	..	1	6	18	21
British East India	4	1	..	..	5	16	3	..	..	..	3	3	2	2	..	..	4	4
Mauritius	5	1	1	3	01	3	5	1	3	3	12	2	3	0	4	2	9	2
Cuba	3	1	1	4	8	5	..	1	1	..	2	2	1	..	1	2	4	9
Porto Rico, &c. ..	1	2	..	1	3	4	..	1	..	..	1	1	..	1	..	..	1	4
Manilla & Java ..	13	9	1	5	29	39	5	3	2	5	15	6	4	3	..	1	8	9
Brazil	..	10	..	6	16	14	..	7	1	2	11	7	..	5	1	2	8	9
Beetroot, &c.	8	2	1	14	25	10	6	3	2	23	33	22	3	4	3	16	26	27
Total, 1872 ..	40	26	5	37	108	108	23	18	10	36	86	55	24	17	10	28	79	83
Total, 1871 ..	56	29	7	16	slight increase		15	13	9	19	31 increase		28	17	8	30	4 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

The dullness which prevailed during the whole of January has not given place to any better state of things. Prices have given way another 1s. or 1s. 6d. per cwt., No. 12 Havanas afloat being quoted at 28s. 6d. to 29s., Cuba muscovados at 26s. to 26s. 6d.; middling to good Bahias 23s. to 24s.; and good to fine brown Pernambucos at 24s. to 25s. Common refined lumps are worth 39s. 6d. to 40s. in London.

Imports since the opening of the year, and especially during the early part of the past month, have been greatly in excess of last year, the total imports of the four ports to the 17th February being 86,206 against 54,999 tons to the same date in 1871. Deliveries during the first seven weeks of the year are about 4,000 tons below those of last year. Stocks for the first time for many months are slightly in excess of those at this period both in 1871 and 1870.

The estimate of the present season's continental beet sugar crop remains about the same, still showing a reduction of 100,000 tons below that of 1870-71, though as the season advances it appears that the yield in France will be rather heavier than was anticipated when the rasping was commenced. Accounts from several of the West India Islands of the crops now being cut are not encouraging, leading to the conclusion that the yield will prove below the average.

The chronic insurrection in Cuba tends to increase the cost of production in that island. Planters and holders of sugar there evince no disposition to submit to lower prices, especially as their chief market, the United States, does not share in the dullness felt so widely in Europe. There is no question but that the increased duties in France and the consequent unsettlement of the sugar trade there, is one of the chief causes of the general depression which prevails on this side the Channel. All things considered, there is no reason why the present depression should be more than temporary.

THE
SUGAR CANE.

No. 33. APRIL 1, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

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ON THE MANUFACTURE AND REFINING OF SUGAR.

[*The Cantor Lectures, delivered before the Society of Arts.*]

By C. Haughton Gill.

(Continued from page 127.*)*

Lecture III.

I shall enter to-night upon the consideration of a process of manufacturing sugar from beet root. I say a process, because there is more than one employed, and I shall not have time to describe them all. I shall therefore describe the process which, up to a recent time, at any rate, has been most generally employed, and which is, on the whole, the most easy to understand. I shall not enter into the nature and culture of the beet root, for it has been very ably discussed before in this room, and I can add nothing whatever to what has been said on the subject. The roots, however, I may say, require tolerably deep soil, and when grown under fair conditions, yield a crop of from fifteen to twenty tons per acre. On the table are some specimens of roots grown in England, for which I am indebted to the kindness of one of the large London sugar refiners, Mr. James Duncan, of Lavenham. Some of these sugar beets are rather larger than is considered good as a rule, for it is found that the larger beet roots, generally speaking, contain juice much poorer in sugar than smaller ones. A root, to satisfy the requirements of a sugar-maker, should be of a regular shape, and free from rootlets. One of these I will cut in half, that you may get a general idea of the internal structure. You see that it is built up of a number of concentric rings, which, of course, are formed of a great number of small cells, each cell being filled with juice, that is to say, a watery solution of many bodies, including sugar. Of the non-saccharine constituents, I may mention the phosphates, oxalates, citrates, malates, and chlorides of potassium, sodium, and calcium, some bodies resembling albumen, if not identical with it, and other gum-like, but little known, substances belonging to the class of colloids. Besides these, there is a small quantity of material which rapidly changes colour when exposed to the air, and becomes black, just as a similar body does which is contained in the juice of walnut rinds. The percentage of sugar in these white beets varies greatly. I have analyzed English grown roots with as much as sixteen per cent. of sugar, and others with not more that six. To what a degree of richness the roots may be brought is shown by the fact that some Austrian roots have been found to contain eighteen or or even nineteen per cent. of sugar in the juice. The object of the sugar-maker when he has got the juice is, of course, to remove as many as possible of these impurities, and then to get out from the remaining liquid as much of the sugar as possible. I will point out, later, a reason why he is unable to extract the whole of the sugar from the juice that he wins.

The first operation performed in a beet root manufactory is to wash the roots, which is done by a machine made for the purpose. This washing, which ought to be performed very carefully, being over, the roots are passed onwards, and are freed from the upper part, or crown, from which the leaves spring, and also from any worthless or decayed portions which may be noticed upon them. They then go to a machine, in which they are rasped up into a fine pulp. I have not a diagram showing the structure of this machine, but it practically consists of a drum, from eighteen inches to two feet in diameter, and two feet long, the whole circumference of which is set with a number of saw blades, with teeth just sticking out of the circumference. This drum is caused to rotate with great rapidity, performing between 700 and 1000 revolutions in one minute. Near to it is a straight steel edge, and as the roots are passed into the hopper of the machine they fall down, and are rasped against these rotating saw teeth, and, of course, as the teeth come round, they scrape out from the root a number of small strips, and gradually the roots are rasped up into a sort of pulp. Here is a specimen of the pulp, produced by an ordinary grater, which has somewhat changed colour, owing to the presence of the bodies which I just now mentioned. This pulp, which in practice is much wetter than this, because the manufacturer allows water to run into the machine while the roots are being torn up, is next folded up in a number of cloths made of coarse flannel; the pulp is put into the centre of the cloth, the edges of which are folded over, so that it is made into a kind of square cake. It is then put upon an iron plate, another plate upon the top, then another cake of pulp, and so on, till there are fifty, sixty, or seventy cakes piled one above the other. These packets are all put into a powerful hydraulic press, which is caused to exert a gradually increasing but finally very great, pressure on the mass. Of the 95 or 96 per cent. of juice which the roots contained 80 to 85 are obtained by this method. Where the process of diffusion is adopted 94 to 95 per cent. is the practical yield of juice. The juice, as it is pressed out, runs into a vessel prepared to receive it, in the same way as it does from this mass which I squeeze with my hand. It is then somewhat dark coloured, as it contains all the impurities I mentioned before, and has now to be clarified. If we simply boil it, as I have boiled some similar juice here, we do get a partial clarification, for the albuminous constituents coagulate in the same way as the white of an egg sets when it is heated, and form a kind of scum on the surface. The coagulation is by no means very perfect. But it is found that by the addition of some lime the process of coagulation, and consequent running together of many of the other constituents, is very much facilitated, owing to the formation of insoluble lime compounds. But this addition of lime prevents the coagulation of the albumen itself, which, therefore, remains in solution till it is partially destroyed by being boiled in the alkaline solution.

To illustrate this, I have put into a beaker a quantity of beet root juice, and I will now add a small quantity of milk of lime, that is to say, ordinary quick-lime which has been slaked in water, and then stirred up to a thin cream. I will stir the two together, when the effect is, that the liquid immediately appears to grow whiter in colour, and there is now a quantity of small clots formed in the liquid. These will gradually collect together, and rise towards the surface, forming a kind of scum, and we find below, a clear liquid of a moderate yellow colour. The juice will thus be clarified, or, as it is technically termed, defecated. This defecation is performed on a large scale in this way. The juice running from the presses is allowed to go into some large copper heaters, holding about 500 gallons each, and to each of these a quantity of lime is added which is equal to about one per cent. of the weight of the roots from which the juice has been obtained. Before the lime is added, however, the juice is heated to a temperature of about 180° Faht. The lime being added, the coagulation commences, and then the heat is raised slowly by turning steam into the jacket of the pan. As the liquid approaches boiling-point, a scum arises in the way I have described, and as you will see takes place here in a few minutes. I can show you the effect more easily by exhibiting a sample which Mr. Duncan has sent me of the juice after it has been clarified. Here is some of the original juice, which comes from the sugar factory at Lavenham, not only the first, but the only beet root sugar manufactory in England; and here is some which has been subjected to the treatment I have described. It has been heated, the lime has been added, the scum has been allowed to rise, and the clear liquid has been drawn off. You will observe the great difference in the apparent purity of the product. I should add, in fairness, that this purification is even greater in appearance than it is in reality, for the quantity of impurities removed by this process of defecation is much smaller than the change in appearance would lead one to suppose. The next stage of the operation is this:—The juice defecated by the action of the lime still contains a considerable quantity of lime in solution, for though much of the lime which has been added has combined with the organic acids and other matters which were present in the juice, and has separated in the form of scum, still a great portion remains behind, and gives to the juice a distinct alkaline character, which, as I explained to you last time, is detectable by means of a turmeric or litmus test-paper. I have not explained exactly what I mean by alkaline character, but have only told you it is that character which lime, soda, and potash possess of neutralising acids and turning vegetable colours in the way I have shown. I pointed out, for instance, that an alkaline solution is capable of turning turmeric paper brown, and by applying this test to some of this defecated juice, you will see that it is distinctly alkaline in its character. This is due, at any rate for the most part, to the presence of an excess of lime dissolved in this weak solution of sugar. Before the manufacturer can advantageously treat the solution so as to obtain sugar crystals, he is compelled to remove a great part of this lime by some process or another; and that which on the whole is most economical, and most usually applied is the causing of the lime present in such a solution to unite with carbonic acid gas, which, as I showed you before, forms a compound which is insoluble or very slightly soluble in a sugar solution, and thus separates in the shape of a white powder.

I can show that, in this particular case, by passing some carbonic acid gas into this solution, which, however, should have been boiling hot, as the decomposition would have been much quicker. I dare say you can see, however, that the liquid has become cloudy, and this cloudiness is due to the fact that the carbonate of lime, formed by the absorption of the carbonic acid by the lime held in solution is insoluble, in the solution of sugar, although the lime itself is exceedingly soluble. This solution, after it has been well saturated with carbonic acid and boiled, will have lost, in a great measure, its alkaline character, but not entirely so; for this alkaline character is due not alone to the presence of lime, but also to the presence of some bodies, such as soda, which have been liberated from combination by the lime previously added, and they, being soluble, do not fall to the bottom. When this operation is performed on a large scale, the workman continues to pass gas into the hot solution until he finds that the precipitate which forms, clots together pretty readily, and sinks rapidly to the bottom of the vessel. He takes this as an indication that the operation is practically complete, the settling of the precipitate marking the termination of the action, and showing that nearly all the lime has become combined with carbonic acid, so as to become insoluble. I will filter some of this solution—when you will see it is pretty bright, and of a somewhat paler colour than it was before. This diminution of colour, which really takes place when the operation is performed carefully, is greater in proportion to the quantity of lime that was present before carbonation, and is due to the fact that the carbonate of lime, as it is formed and precipitates, combines in a loose sort of way with a certain quantity of the colouring matter present, and carries it down into the sediment. In fact, the carbonate of lime forms with the colouring matter a kind of "lake," in the same way as alumina forms the ordinary lakes used in painting, when it is precipitated in a solution containing a vegetable colouring matter. On proving this filtered solution with the turmeric paper, you see that the colour produced is much lighter, and by the continued saturation of the liquid with the carbonic acid, this change would have been more marked. I must now show you another experiment. In this glass I will put merely a solution of lime in water, adding some more distilled water to make it weaker. I will now pass carbonic acid gas into that. You see the action takes place immediately; the lime combines with the carbonic acid, and forms carbonate of lime, in the same way as it does in the solution of sugar. But what I want you to observe in this experiment is this, that on continuing to pass carbonic acid into the lime-water, until it is present there in excess, the carbonate of lime which was first precipitated will be dissolved, that is to say, the excess of carbonic acid re-dissolves the carbonate of lime first formed. It is very important to establish this point, but you must remember that this only takes place permanently in a cold liquid. Thus, if we heat the solution so obtained to the boiling-point, the carbonate of lime which has been dissolved owing to the excess of carbonic acid will be re-precipitated again. It is necessary to remember this, in order to understand why, when in a sugar factory they pass carbonic acid gas in to precipitate the lime held in solution by the juice, and, when the action is apparently complete, they are obliged to boil the liquid pretty vigorously for some time, for if they did not do so a quantity of the carbonate of lime which had been first precipitated would remain in solution, being re-dissolved by the excess of carbonic acid, and, what is worse, at the time the carbonate of lime is dissolved there is also dissolved the organic matter which that carbonate of lime previously carried down with it. You see, no doubt, this solution is already becoming clear again, the carbonate of lime being dissolved by the excess of carbonic acid; but upon boiling the clear liquid, you again see, as it gets hot, the excess of carbonic acid present is given off in bubbles, and in a few minutes the carbonate of lime dissolved will be re-precipitated, though not quite in the same way as before, but in a much more crystalline form, and it will adhere much more to the side of the glass, and therefore be less visible.

Supposing that this operation has actually been performed in the factory, that the juice has been first defecated, then saturated or carbonated with carbonic acid, that the excess of lime in the juice has been removed by carbonation, we get such a product as is contained in this bottle, which also comes from Mr. Duncan's factory. The juice has now, in a great measure, lost its alkaline character, having been deprived of the greater part of the dissolved lime by means of carbonic acid. There is, however, still some lime to be removed from the juice, and there are also contained a considerable number of those gummy and albuminous bodies which I before mentioned. These are partially removed, and at the same time a considerable portion of the colouring matter which gives this brown tint to the liquid, by passing the juice through animal charcoal. This is done by taking the juice coming from the carbonating pan into an iron cistern, and there heating it nearly to boiling-point, and from there passing it into the top of tall vessels 15 or 16 feet in height, and 2½ to 3 feet in diameter, and filled with granulated animal charcoal. The juice finds its way through this charcoal gradually to the bottom, and runs out while a fresh supply is poured in at the top. As I showed you last week, the animal charcoal has a considerable power of absorbing bodies, such as dextrine, and if you give it a longer time and the liquid be hot, as in the case under consideration, the action is considerably increased and the liquid undergoes a very material purification. I have here some juice which has been defecated, carbonated, and also passed through the animal charcoal; and you will observe that the result is very much less coloured, the juice now being a very pale yellow tint, and a great portion of what small quantity of lime had been left in it by the carbonating process has been now removed, together with a material portion of the gummy matters. The carbonated juice might be sent up to the cisterns, in which it is held before it comes down to the animal charcoal, by means of common pumps, but it is not found advisable to do this in a beet root sugar manufactory, because the inside of a pump is not very readily cleaned ; and when beet root juice is allowed to hang about, for even a comparatively short time, it begins to undergo a kind of fermentation ; and when the juice contains, even for a very short time, any fermenting body, a considerable portion is converted into non-crystallisable sugar. Here is some beet root juice which has been standing for some time in a bottle, and whereas in its natural state it flows freely, you see now it has become slimy and thick. Beet root juice very readily passes into this state of fermentation, and, as it is difficult to use a pump without leaving behind in different parts of the apparatus a small quantity of the juice or of the pulp which is carried with it, and which soon gets into this sticky, slimy state, the operation of raising the juice to the iron cistern is performed by an apparatus called a juice-lifter, of which I have here sketched a rough diagram. It consists of a wrought-iron cylinder, from the bottom of which proceeds a pipe leading to the cistern at the top of the building, whilst a branch from the same pipe communicates with the reservoir of juice to be lifted. The top of the cylinder has two openings, one communicating with the external air, and the other with a steam boiler. On opening the cock communicating with the air, and also the one communicating with the juice to be lifted, the iron cylinder is soon filled with the juice. These two cocks are then shut off, communication is made with the cistern to which it has to be lifted, and, at the same time, steam is allowed to enter from the steam boiler, and the pressure of the steam soon forces the whole of the juice in the cylinder into the cistern above. This apparatus, therefore, has the double advantage that none of the juice is left behind, and at each operation the vessel is thoroughly cleansed and scalded out by the action of the steam.

(*To be continued.*)

THE BRITISH REFINERS AND THE CONVENTION.

By John Neill, Jun., M.A.

In the *Journal des Fabricants de Sucre*, of 22nd February, 1872, there occurs the following sentence—

> "Les raffineurs Anglais ne voient de solution que dans la dénonciation de la Convention."

That sentence contains an error, to the correction of which a few sentences may be well devoted.

The refiners of the United Kingdom do not seek to denounce the Convention of 1864; they merely seek to modify it in such a way as to more effectively carry out its object, and the means they propose, namely—refining in bond in all the countries parties to the Convention, is as we shall now show, an improved method of arriving at the end proposed.

In the Convention the refiners have always recognised a *bonâ fide* attempt to establish an international arrangement for the suppression of all bounties, whether direct or disguised, on sugar. That this was clearly its aim is proved by the following among many passages that might be quoted from official papers.

From report of Sir Louis Mallet and Mr. Ogilvie, 6th October, 1866:—

> "The object of the negotiations which have led to these results was to effect the abolition of all bounties, which might be given to the refiners of any country in the amount of drawback allowed on the exportation of refined sugars."

From Board of Trade memorandum, January, 1868.

> "The immediate object of the negotiations was to secure in each country the effectual suppression of all bounties upon exportation, in the shape of excessive drawbacks or discharges."

The means for arriving at this desirable end (an end which of course must commend itself to all free traders,) was by grouping raw sugars in various classes giving different yields of refined, and charging a duty on each class of raw, proportional to the quantity of refined it would yield.

If the yield was correctly fixed the drawback question was at once placed on a satisfactory footing. Thus if a raw sugar which would yield 80 per cent. of refined was charged, 80 per cent. of the drawback allowed on refined on export, the Customs on export would return as drawback only the exact amount received as duty. For example, if the drawback on the export of refined were 10s. per cwt., the duty on the raw sugar yielding 80 per cent. would be fixed at $\frac{80}{100}$ of 10s. = 8s. On every ton imported a duty would be paid of £8, and on the yield, viz., 16 cwts. there would be allowed a drawback at the rate of 10s. per cwt. = £8. Thus the Revenue would lose nothing by exportation.

And not only would the Revenue be protected against loss by exportation, but it would be put on a fair footing with regard to home consumption, as none of the sugar consumed in the home market could escape taxation, and it would be immaterial whether the sugar was imported in a state ready for consumption, or in the form of raw material, to be made fit for food in this country. Every ton consumed in the country if brought in, in the finished state would pay £10, the duty on import being the same as the drawback on export. On the other hand every ton consumed in the country, if made in a refinery from a raw yielding 80 per cent. would have been produced from 25 cwts. of that raw, which on import has paid at the rate of 8s. per cwt. = £10. Thus the imported sugar and the product of the refinery would go into consumption on an absolutely equal footing.

It is evident that the accuracy of this result depends entirely upon the accuracy with which the yield of the raw is predetermined, for if the yield from the lot we have selected for illustration be not exactly 80 per cent. there will be a loss either to the refiner or to the Revenue. If the refiner cannot get 80 per cent. yield he does not get back in drawback on exportation the whole of the duty he has paid; or if he destines his product for home consumption it stands him at a higher rate of duty than a similar product which has been charged on importation in the refined state. On the other hand, if he can get more than 80 per cent. yield, he gets more drawback than he paid duty if he exports; or if he makes for home consumption his product stands him a less duty than the imported refined he is competing with, or, what is the same thing, the 80 per cent. stands him at the same duty as the imported refined *and the excess of yield goes untaxed into consumption.*

Now, raw sugars give an infinite variety of yields, and the Convention grouped them into four classes, and took the average yield of each class as determined by a series of actual experiments. As a matter of course each class comprised some sugars better and some worse than the average. Here then is the first element of failure in carrying out the object of the Convention. The yield is fixed on the average of a class: but by selecting the best sugars of each class an excess of yield and consequent bounty must be obtained. The higher the scale of duties, the greater will be the money difference between the classes, and the greater the inducement to take full advantage of this bounty.

The second element of failure is in the criterion of classification adopted by the Convention, viz., colour. In 1864 colour was to a far greater degree than now an accurate measure of the sugar producible from a given lot of raw, indeed so accurate as to be practically trustworthy, now it has become not so. At that time the value of sugar was practically determined by its colour; now to a large and increasing extent value is tested by analysis and not by appearance. A sugar may be naturally, and can easily be made artificially of a low colour conjoined with a high saccharine richness. Such a sugar taxed on the Convention principles pays too low a duty, for it is assessed in too low a class with reference to its actual yield, and the consequence is that a portion of its product goes untaxed into consumption, or, if exported under drawback, more drawback is received than duty was paid, in either case to the loss of the Treasury, and the gain of the refiner. The higher the scale of duties, the greater is this loss to the Treasury, and bounty to the refiner, and of course the greater the inducement to lower the colour of the raw artificially.

To meet these points where the details of the Convention fail to attain the fulfilment of its object some modification is necessary, which shall classify raw sugars as to their yields without possibility of error and without large steps between class and class.

Refining in bond supplies a perfect and practical solution of this requirement. The raw material will go into the refinery and no guess will be made as to the quantity of refined it can or should yield. It will be ascertained by working what it absolutely does yield, and thus it will find its own exact position in the scale, a scale which is independent of averages, and where the intervals are infinitely minute. On the actual yield the duty will be paid on all goods intended for consumption, on goods for export, no duty having been paid, no drawback will require to be given.

Thus then the proposal which the refiners of the United Kingdom have been urging on our own, and the foreign governments is by no means a denunciation of a Convention whose object was the suppression of bounties and whose principle was the classification of sugars according to their probable yields, but rather, in the words of the Refiners' Memorial, "a method which gains, without failure, the same end by an improvement on the same means."

ANALYSIS OF SUGAR AND MOLASSES.

[A TRANSLATION OF THE REPORT PRESENTED BY M. WOUSSEN TO THE CENTRAL COMMITTEE OF THE SUGAR MANUFACTURERS OF FRANCE.]

(*Concluded from page* 134.)

THE CO-EFFICIENT 5.

We have shown that in order to estimate the commercial value of a raw sugar by chemical analysis, the total quantity of [pure] sugar is determined by the polariscope, but admitting that the salts prevent the crystallization during refining, the quantity of the salts is calculated from the ash of the sugar, diminished by one-tenth after incineration.

If then a raw sugar contains 95 per cent. of pure sugar, but gives 2 per cent. of ash (after the deduction of one-tenth), this is taken into account in the valuation of the sugar, and in actual commercial usage it is taken for granted that this 2 per cent. of ash will prevent the crystallization of 5 times its weight of sugar. Thus then 5 times 2 is deducted from the richness of the sugar analyzed, and it is considered as containing only 85 per cent. of extractable sugar.

On what the adoption of this co-efficient is based we have no knowledge, and can only conjecture that it arose in the following manner:—

The analysis of sugars with respect to their saccharimetrical standard and to their saline impurities was (as advised by M. Dubrunfaut) practised by refiners long before it became a commercial custom. Probably refiners comparing the average of their analyses with the production of their refineries during a year, for example, have remarked that their actual out-turn was inferior to the amount of sugar shown by the polariscope, by a quantity represented by five times the weight of the ash which the sugars were supposed to contain, and thus in judging by polarimetrical assay, and incineration of the probable yield and value of a sugar, they adopted the co-efficient 5 without proving that the deficit found in their returns was wholly the result of the salts, or partially from other causes operating simultaneously, such as loss of sugar in the char, or in the scum, or from accidents. The loss was assumed to be due to the salts.

When the analysis with the co-efficient 5 became common in business, it was found that thus calculated it corresponded exactly with the usual difference in price between the different types and their average analyses, and the same differences of price have been continued and consequently the same bases of calculation.

But since studies of this kind have become more common, some experiments have been made of a very precise character—especially in connection with the influence of the salts—respecting the general results, comprising all the losses of refining, and it has been shown that in reality the salts do not render uncrystallizable a quantity of sugar equivalent to five times the weight of the sulphated ash obtained by the incineration of the sugar.

If it is admitted that in the refinery the salts produce in the working the same effect as in the manufacture of raw sugar—and that we think should be admitted when acting on the same material—the co-efficient of the action of the salts appears to be only 3·6, as is shown thus: Many analyses have been made of molasses from sugar factories, when these molasses have been considered to be exhausted, that is to say, when they would give up no more crystals even if re-boiled and kept in conditions favourable to crystallization, and the proportion between the sugar shown by the polariscope and the weight of the sulphated ash (diminished by one-tenth) has been on the average of the experiments 3·6 of sugar for 1 of ash.

Thus in the manufacture of raw sugar the average results show that crystallization ceases when the quantity of salts accumulated in the syrups is such that the sulphated ashes of these salts show the proportion of 1 to 3·6 of sugar.

This is a fact which may be asserted. It only remains to discuss the causes.

Many chemists have for some time past studied the relative action of pure salts on the crystallization of sugars, and have arrived at results negative on one side and positive on the other, but these experiments, conducted with great care and exactness from their point of view, do not accord with the results of manufacturers.

From the results of their experiments some chemists have come to the conclusion that certain salts do not produce molasses, that is to say, they do not prevent the crystallization of sugar; but however, it is proved in manufacture that when these salts are in molasses, this molasses, if re-boiled, will not crystallize further, and if these salts are extracted, by the osmose process, for example, the molasses re-boiled will begin to crystallize again and yield sugar in greater or less quantity. Whether these salts act alone, or in combination with the action of other foreign matters is not known, but this is certain, that when the salts disappear the molasses crystallize afresh; and that on the average the quantity of sulphated ash corresponds to a certain quantity of sugar which will not crystallize, and in practice this proportion is 1 of sulphated ash to 3·6 of sugar. It may then be concluded that when a molasses gives by sulphuric incineration a weight of ash corresponding to 1 for 3·6 of sugar this molasses will not crystallize further.

As the result is always the same, the sulphated ash may be accepted as the measure of the uncrystallizability of the molasses or of the boiled syrup, although the salts may not be the only cause of it; the coincidence is invariable, and it is better to accept this method of measurement than to have none at all. And this seems to be an answer to all theoretical discussions on the subject.

We will only add that some persons suppose that the salts and other foreign matters which accompany them in proportions which vary but little, have the same effect as water on the boiled molasses, that is to say, that taking a solution of pure sugar it would contain when sufficiently boiled say 20 per cent. of water. In these conditions it may crystallize, because when cold water will only dissolve twice its weight in sugar. But in the case of an impure syrup when it is so thick that it cannot be boiled longer, this syrup contains besides the 20 per cent. of water considered as foreign matter, 20 per cent. of other foreign matters in solution, that is to say also in a liquid state, it is as though it contained 40 per cent. of water, and therefore it will not crystallize.

But whatever the value of this hypothesis, the salts being the only tangible foreign matters which can be separated and weighed, their proportion to other foreign matters being only slightly variable, it appears to us, to be wise to accept the testimony which they give, that is to say, to adopt the co-efficient 3·6 instead of 5.

We believe then, that the new co-efficient 3·6 ought to be adopted in the sugar trade. Evidently, in order to be just, the variations in price according to the standard must be charged proportionately at the moment of transition, because it would not be reasonable that a sugar which the night before was valued at 60 francs for example, because by the co-efficient 5 its standard was 88°, should be worth the next day 62 fr. 25 c., because (under the new co-efficient 3·6) its standard was 89°8, unless the currency was changed, but once the new system was established the relative estimates of the intrinsic values of sugars would be more just.

We may suggest further, that during the transition the scale of difference in value should not be altered, but the standard of the base raised from 88° to 90°.

In concluding this, relating to the co-efficient to be adopted, we should add, that the experiments which we have made on the molasses from the sugar factories (refining molasses would not have served the same object) have been all made on those molasses which contained little or none of the salts of lime, because we did not wish to admit this cause of error. It remains then, apart from the adoption of the co-efficient 3·6, to ascertain what would be the co-efficient which it would be proper to adopt for the ash proceeding from lime and the salts of lime, which we have spoken of above.

To determine this co-efficient it would be necessary to make some practical experiments in the refinery, but this we are not able to do at present. When we shall have collected sufficient facts on this head we shall feel it our duty to communicate them to the manufacturers of sugar.

ON THE DIFFERENT METHODS OF APPLYING THE OSMOSE PROCESS IN THE SUGAR MANUFACTURE.

By M. Dubrunfaut.

Translated from "La Sucrerie Indigène."

The osmose process has generally been very successful when the rules for its application have been adhered to, and it is only when these rules have been neglected that some manufacturers have obtained doubtful results. It may therefore be needful to revert to these particulars, and to indicate the conditions of its rational application.

The osmose process eliminates the salts which hinder the crystallization of the sugar, but this property, which is founded on the difference in diffusibility of sugar and of salts, can only be properly applied to the purification of syrups or molasses containing the salts of potash, soda, or ammonia, or the salts of magnesia, which also possess considerable diffusibility: but the salts of lime possess little or none. We may thus comprehend that the osmose process is powerless to purify those syrups which contain much salts of lime; such syrups, in fact, instead of being deprived of these impurities, will actually show an increased proportion of calcic salts, by being passed through the osmogene.

This may, however, be remedied by treating the syrups containing these salts in such a way as to transform the salts of lime into salts of soda, potash or ammonia. This result may be realized by the use of a carbonate, a sulphate, or an alkaline phosphate. Economically, crystals of soda are to be preferred, and the quantity to be used may be determined by multiplying by 5 the calcic standard of the molasses, shown so readily and exactly by Messrs. Boudet and Boutron's hydrotimeter.

From this point of view, syrups but slightly calcic are the best adapted to the osmose process, such as the syrups or molasses of the large establishments where the calco-carbonate mode of working is practised.

The old factories where the alkaline working is carried on produce on the contrary syrups more or less calcic,* and these syrups do not yield to osmotic purification, unless the working has been conducted with this end in view. Nothing is more easy, however, than to avoid this inconvenience by ascertaining the calcic standard before the concentration of the juice, and in transforming the calcic into the sodic before clarification. Syrup thus treated is found to be free from lime, and it submits to the osmose treatment apparently as well as syrups from establishments where the new methods are practised.

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* This defect is met with especially in syrups produced in the working of injured or tainted beet roots which contain glucose, which in this case is transformed into glucic acid, and consequently into glucate of lime, which the osmogene will not eliminate.

The osmose process has no action on colouring matter, consequently osmosed syrups are more coloured, because the colouring principle has been concentrated, with the sugar, without any elimination whatever.

It would be unreasonable to expect from the osmose process effects which it cannot produce, and to practice it without adopting the other well-known methods of purification (animal charcoal, the calco-carbonic treatment, &c.) in their proper places. In fact, the osmose process is to be used in addition to other acknowledged purifiers; and has never been represented as a panacea, capable of abolishing the use of old systems. But we believe that the osmose is a great step in advance, and a great addition to the means of purification at the disposal of the sugar industry, and that it contains elements useful in the solution (long sought for) of a problem of which we will speak further on; but these results can only be obtained by reasonable practice, and without renouncing any of the good purifying processes in use.

Three methods present themselves for the logical application of the osmose. We will take them in the chronological order in which they have been offered for trial.

Partial Purification of Syrups from the Second or Third Crystals in the Sugar Manufactory.

This method has been practised since the invention of the process, and it is still carried on with success in many factories, where it has been found very useful. In principle it is only applied to those syrups which could be profitably worked without it, that is to say, which by simple reboiling would yield a productive crystallization. The osmose is in this case a very simple operation, which entails some loss in the water.

The syrups are passed into the osmogene at their normal density, usually 25° or 30° Baumé, so that a weak osmose is practised, by which some strong saline water and little sugar (which constitutes the loss) are extracted from the syrup. This purification easily eliminates one-fourth of the existing salts, that is to say, 2·3 to 3 per cent. of the weight of the syrup, and if we take the co-efficient 4 to calculate the sugar set free, the osmotic purification thus increases the yield of sugar by 10 to 12 per cent., which added to the normal return of the syrup, proves the practical utility of the method.

Admitting that the syrup in question, not osmosed, would yield 25 per cent. of sugar on the weight of the *masse cuite*, if this osmotic purification raises the return to 35 per cent. of less saline sugar, the economic utility of the process admits of no doubt, inasmuch at an expense of 1 fr. per 100 kilogrammes of syrup it adds to the usual return of 25 per cent. a supplementary return of 10 per cent., which is effected in the same working with scarcely any extra expense, and with the time of crystallization relatively less.

Yet this real advantage does not appear to have struck all manufacturers, and it has even been thought as too small for consideration. This method of working, however, is the one which is practised by Messrs. Gouvion, Woussen, Beaupère, Carmichel, Charbonneau, Augt. Dumont, Lalande, &c.; all sugar manufacturers of high standing.

Some prejudice exists against the process in those sugar factories where the calcic purification is practised, probably because it has not been tried; it may, however, be affirmed that the economic results obtained in these establishments would have been much increased if the osmogene had been used.

Purification in the Sugar Distillery.

This working which has been described in former publications is here applied exclusively to molasses, and is undoubtedly, when well carried out, one which will give the greatest chance of profit.

In this case the waters of exosmose are utilized in fermentation, and thus the perfection of its working does not lie in the very limited application of the osmose, which the loss in the water imposed in the preceding case.

The syrup must be strongly osmosed; indeed, it need not stop short until two-thirds or three-fourths of the salts are eliminated.

In fact, if the osmose process is applied to molasses by themselves uncrystallizable, and if, to take the example above given, of the syrup of the second or third crystallizations, the process so applied as to eliminate one-fourth of the existing salts, sets free 10 to 12 per cent. of sugar, which to be extracted and leave a mother liquor saleable as molasses would demand three or four months in which to crystallize, as does the last normal product of our factories, we can understand that such a working, which would require great expense and a long time to produce a little sugar, would justify the application of the adage, "the game is not worth the candle."

Such an insignificant result would only be the necessary consequence of an illogical application of the process. Such would be the position of a manufacturer who, not able to utilize the waters of exosmose, and obliged to waste them, should persist in osmosing his molasses before taking measures to use the waters, and his negative results would merely be the consequence of improper application.

If, on the contrary, with a moderate osmose half the salts were extracted from a molasses containing 12 per cent., there would be set free in extractable sugar at the co-efficient 4, $6 \times 4 = 24$ per cent.; and if to obtain this result the water of exosmose was made of a co-efficient zero, we might reasonably hope to obtain by this working $24 - 6$, that is to say, 18 per cent. of sugar.

If, on the other hand, the use of the waters in the distillery opposed no limit to the extent of the osmose process, three-fourths of the salts might be extracted at a co-efficient zero, and the real extractable sugar set free would then be $36 - 10$, that is, 26 per cent., a figure which has been realized in actual manufacture.

We may thus comprehend all the advantages which would accrue to sugar distilleries able to extract from their molasses much sugar or much alcohol, according as the state of the markets made either desirable.

Many establishments work, or are about to work, in this way.

There are those of MM. Dantu-Dambricourt, of Steene; L.

Crespel & Co., of Quesnoy-sur-Deule; the new establishment started by M. Durin, and possibly also that of M. Bugnot-Colladon, Besançon.

There is an opening in Paris for an immense establishment of this kind, which could profitably be supported by the molasses of the Paris refiners, and this establishment would be especially encouraged by the transformation at present taking place, that is to say, by the general adoption of the alkaline working which is there being carried out in different ways, and by which 60,000 kilogrammes (about 60 tons) of molasses are supplied daily, free from glucose and lime, and perfectly suited in all other respects to the osmose purification; such for example is the molasses produced in MM. Sommier & Co.'s refinery.

PURIFICATION IN THE SUGAR MANUFACTORY.

This application, the great importance of which we have insisted on for a long time, has scarcely attracted the attention of many eminent manufacturers, who would have been able to carry it out most intelligently and usefully.*

The *masses cuites* of the first crystals generally show (save in some exceptional manufactories) a co-efficient of 12 or 13, and those of the second crystals have a co-efficient of 6 or 7. The first only can be boiled to grain, the second will not bear it, for which reason manufacturers by the improved process fall back on the slow working of the low products which is the characteristic of the old process.

The means of avoiding this inconvenience has often been sought, and especially from the pretended sucrates of lime applied to the syrups from the first crystals, but the solution of the problem has been sought in vain.

Meanwhile, what advantages would not our process confer in the sugar manufactory: 1st.—Sugar only of the first crystallization would be made, the drainage from it being continuously returned. 2nd.—From the molasses a saleable first product of manufacture could be made, and thus avoided, with very great advantage the formation of impurities which constitute the molasses, the injurious satellites of the sugar during the long continuance of the operations. 3rd.—To avoid altogether the working of low products and their obstruction in the *usine*, so as to be able in 12 to 15 days after the conclusion of the rasping completely to finish all the products of the season. Such in our opinion might be the results of the osmose process, although no manufacturer has yet tried the experiment except M. Hette, who made a single incomplete trial in 1868, and who from reasons unconnected with osmose did not continue it.

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* The application has especial claims upon those great establishments whose syrups are exclusively suited to the osmose process, which might by its application be saved from the interminable and troublesome working of low products.

We are thus necessitated to demonstrate from simple theoretical considerations dependent as far as possible on what has already been described in our former works.

To solve the problem in question, it would be sufficient to reduce the saline co-efficient of the second crystals to the same level as the first, and if that is shown to be possible there is no longer any doubt on the subject. The question is in short whether the co-efficient of the seconds, which is 7, can be raised to 12 or 13, which is the average co-efficient of the first, which can be boiled to grain. This result may evidently be obtained by the elimination of the better half of the salts from the syrups in question.

This result may certainly be secured by making a strong osmose, and consequently making the waters of exosmose of such a saccharine strength that they must not be wasted. It will thus be needful to resort to some practicable means of utilising these waters. The known means are, 1st.—Using fermentation for the production of alcohol. 2nd.—Concentrating them in some economical manner so as to produce a molasses saleable to distillers, a process which has been adopted by several manufacturers.

The first means is quite practicable by the addition of a distillery to the factory, which could make spirit of a strength saleable to rectifiers. Some fermenting vats and a simple distillery apparatus would only be necessary.

The second means would entail the provision of suitable economical evaporators such as the *triple effet*, supplied by a special steam boiler, and if these expenses are compared with the results which may properly be expected they will not appear unreasonable.

Admitting as an extreme hypothesis, that to raise the second crystals to the level of the first, it is necessary to make the waters of exosmose of such value that they would represent real molasses of a normal constitution; by concentrating these waters into molasses by the *triple effet* we should have perfectly solved our problem, that is to say, the molasses instead of being the last product of the working would be the first, and at the same time the sugar would be obtained as speedily, and with the superior qualities of the first crystals. The solution of the problem is then possible by osmose, and only depends on the simple organization of working and material.

We may add that the eminent manufacturers MM. Woussen and Gouvion, who have practised the osmose process successfully since its invention, have given favourable opinions as to the practical working of the above. M. Gouvion states that he himself had last year made preparations for trying it, but that circumstances prevented his carrying it out.

Application of the Osmose in the Refinery.

In the presence of the proofs of the advantages of this process in the factory where no profit can be made by it out of the duty, we cannot comprehend the absolute indifference of refiners, who would obtain considerable remuneration by working it, merely in extra returns of sugar extracted from their molasses.

The great difficulty here as in the factory, is in the utilization of the exosmose water. The refiners of Paris cannot have recourse to distilling, and their exosmose waters would either be wasted or would have to be concentrated into molasses by special apparatus.

The best method of applying the process in the refinery would evidently be, not to the molasses, but to the syrups from the centrifugals or to the products immediately following them. This method would free the refinery from the trouble of its low products, and would save the molasses part of the working of the centrifugals.

This process is logical, and by its being properly carried out success would be guaranteed.

SUCRATES, AND THEIR APPLICATION TO THE EXTRACTION OF SUGAR FROM MOLASSES.

By M. E. Feltz.

[*Being a translation from the French of an Article written by request of the Council of the "Société Technique Russe," and read before a general Reunion of the Members of the Society, held at Goroditsch, on the 8th of Jan.*, 1872.]

(Continued from page 146.)

The failure of MM. Dubrunfaut, Leplay, and Peligot has not discouraged inventors.

A new process based on the precipitation when hot of the tribasic sucrate, has been patented in France. The inventor M. Lair starting with the fact that sugar forms with many substances, combinations insoluble at a temperature above 80° C. (176° Faht.) mixes with the saccharine liquids, juice or molasses, a proper quantity of lime, and raises the mixture to above 80° C., say 110°, 115°, or 120° C. (230 to 248 Faht.) until it reaches a temperature at which the combination becomes insoluble and is precipitated usually under pressure in the form of sucrate of lime. This patent which has the general defect of patents of endeavouring to include in its terms the known and the unknown has been very judiciously named by M. Tardieu who doubts the possibility of its application "the patent of imagination or speculation." The idea of M. Lair would appear more rational if divested of the obscurity with which it is surrounded, and his process is a step towards the solution of the question. We know that calcareous saccharine solutions become turbid when their temperature is raised to the boiling point, but this reaction depends upon various circumstances which render it very capricious, especially when impure solutions are operated on.

In proportion as the solutions are more concentrated the temperature is raised, and when the concentration is too great there is no precipitate. M. Dubrunfaut published these facts in 1851, and M. Payen has written a very complete work on the conditions under which precipitation takes place.

M. Lair, and in this lies the originality of his idea, avoids all the difficulties in obtaining the regular formation of the sucrate, by producing it under pressure in a *monte-jus* suitably adjusted. The mixture of the diluted molasses with an excess of lime is made in the cold, it is then introduced into a *monte-jus* which besides the ordinary construction, contains an apparatus which allows the temperature of the mixture to be raised according to the pressure of the steam. The sucrate is formed at about 130° C. (266° Faht.). The steam is then shut off from the heating apparatus and the *monte-jus* is worked in the ordinary manner in order to force the limed juice into the filter presses, by the use of which the sucrate is rapidly separated from its mother liquor without danger of its becoming redissolved. The trial of the process in manufacture has however proved that this separation is incomplete.

The syrup obtained after the carbonating of the mass thus pressed shows a decided improvement on that formerly obtained. The manipulation is so easy that nothing prevents the sucrating being repeated as often as needful. However this application of the process in manufacture does not on the whole appear to have produced better results than those of M. Lair's predecessors.

The tribasic sucrate is soluble in sugar solution, but it is insoluble in water. If then we were able to transform into sucrate all the sugar contained in a solution of molasses the problem would be solved. But we have seen that it is difficult to effect, even operating in the cold, the transformation of all the sugar into tribasic sucrate. M. Leplay has overcome this difficulty in a very ingenious manner. After saturating the solution of molasses in the cold with a sufficient quantity of lime, he adds a salt of lime, chloride of calcium, to complete the third equivalent of calcium needful for the transformation of the whole of the sugar into tribasic sucrate. An addition of soda or potash, liberates the lime at the desired moment. The following is the *modus operandi*.

The molasses is mixed with an equal proportion of water for treatment, and sufficient thick milk of lime added to saturate the solution and to leave an excess of lime in suspension. After being carefully mixed more water is added until about 7 gallons, of the solution contains 12 lbs. of the primitive molasses. The necessary quantity of chloride of calcium (either in crystals or solution) is then added and the temperature raised; when it approaches 100° C. (212° Faht.) a diluted solution of soda is added and it is allowed to boil, the mixing being continued. The precipitate is formed easily, it is then taken to the filter presses, and afterwards washed until the washing waters are free from colour. The sucrate thus obtained is worked in the ordinary manner after decomposition by carbonic acid. The process may be applied to juice or to syrups of every quality. The sucrate obtained from second products can be used for melting. It must be remarked that the chloride of calcium may be replaced by any other soluble salt of lime. The salts of lime proceeding from the destruction of glucose are able to replace the same equivalent of chloride of calcium. It will not be impossible to utilize this process in Russia. It must however, be remembered that hydrochloric acid is expensive. On the other hand the ashes proceeding from our steam boilers will furnish after very simple treatment the potash necessary for precipitation, and our calcareous marl the lime needed in the production of chloride of calcium. The process is described at such length by the inventor, the manipulations are so minutely detailed even to the production of carbonic acid gas by a new and ingenious arrangement, that it is difficult to believe the inventor does not base his facts on experiments on a large scale. I have never been able in the laboratory to obtain sucrates from molasses of sufficient purity to pay for the working. It is easy to prove that by the process the greater part of the sugar may be precipitated at one operation, which is a step in the right direction, but the industrial application of the process has not to my knowledge been carried out.

It will be seen that the processes founded upon the precipitation of the tribasic sucrate have not yet led to brilliant results. The other properties of sucrates have also been employed by the discoverers. The property noted by M. Peligot of the production of an insoluble composition from concentrated saccharine solutions has recently been patented for the extraction of sugar by M.

Rousseau. Dr. Stammer studied this product in 1859, he determined the exact conditions of its formation, and a rare thing amongst inventors, he had the courage to publish the entirely negative results obtained. This has not prevented the new inventor from speaking of this sucrate as a reality. I have submitted the process to some experiments, both on a small and a large scale in the laboratory and in the factory, and have not been able to obtain the least advantage over the ordinary decoloration and carbonic purification. Dr. Stammer obtained this sucrate in the following manner: "If the molasses is diluted with water to the density of 53° Brix, 28¾° Baumé, and a sufficient quantity of hydrate of lime in dry powder is added, a fine granulated precipitate is invariably obtained; this precipitate does not easily dissolve in water, and it may be washed several times and thus be obtained clear and pure in colour." But the coefficient of purity of this precipitate is not high. Trial on a large scale gave no better results, and the reading of Dr. Stammer's work will show that this chemist gave up with regret the hope of applying the process to the extraction of sugar. M. Rousseau, on the contrary, prescribes a mode of operation which presupposes a real purification. He submits the syrup to successive sucratations and thus obtains very impure mother liquors. Unfortunately he does not cite any experiments to the point, and his sucrate, analyzed by M. Dubrunfaut, appears to be nothing better than a *mélassate*.*

The process extolled by M. Rousseau does not at all solve the problem of the extraction of sugar from molasses, but it possesses considerable interest in an economic point of view. The Rousseau sucratation provides an easy method of making on small plantations, and with very simple apparatus, an unalterable, marketable product, containing in a dry state all the sugar (and alas! all the impurities) of the juice of the cane or beet root previously concentrated. In case of abundant crops it might be some advantage, even for the large establishments, to form sucrates, in order to hasten the rasping in case of difficulties in boiling. The sucrate might be worked economically during the re-boiling of the "yellows," which would thus be benefited by the carbonating of the sucrates.

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* Note by M. Tardieu in *La Sucrerie Indigène*.—"Notwithstanding the checks which M. Rousseau has met with, both theoretically and practically, he perseveres in the pursuit of his dream, if we may judge from an article which, addressed to sugar refining countries, first appeared in *L'Impartial du Nord*, and was reproduced in *L'Echo Agricole*. We there read: 'A great revolution is prepared in the sugar industry. * * * Instead of being pressed for time, &c. Sucrate of lime can be made, which may be warehoused, like paving stones, wool, or grain, and may be worked afterwards at convenience. The cultivator will rasp his beet-roots, keep the pulp for his cattle, and deliver the sucrate of lime to the nearest sugar factory, receiving the price in the same way as for any other marketable produce.'"

The property which concentrated sugar solutions possess of forming with lime a mixture more or less viscous, becoming a compact mass at the end of a certain time, has given rise to two processes, that of Dr. Scheibler and that of M. Lair. We have seen that it is impossible to obtain from the tribasic sucrate a true sucrate yielding pure syrups. It comes to this, that these sucrates are to some extent *mélassates*, in which there is nothing more, as in the case of sucrate of baryta, than a defined composition of sucrate of lime in an insoluble state. Dr. Scheibler discovered that a proper treatment by alcohol allows this *mélassate* to be washed and the impurities to be separated, and thus a basic product to be obtained ready for the extraction of the sugar. The following is an account of this process:—

Sufficient lime is added to the molasses to form with all the sugar a tribasic sucrate, and the molasses forms itself into a tough mass. Experiment has shown that in this state the sucrate is soluble in alcohol to some extent, but if, on the contrary, the sucrate is dried at a temperature of 110° C. (230° Faht.) a mass is obtained, easily broken and reduced to powder, containing a more stable sucrate. In this state it may be subjected to repeated washings of weak alcohol, and the purified residue may be used at the defecation of the juice. The inventor also proposed to work this sucrate alone. By putting into water it becomes decomposed into soluble sucrate, and nearly two-thirds of the lime is precipitated. This reaction, by which Dr. Scheibler profited, seems to prove that no real combination had taken place of all the lime with all the sugar, and thus explains how the sucrate obtained in this way cannot be washed with water.

Dr. Scheibler does not give details of the results arrived at by his determinations of the yield and of the loss of sugar. He gives, however, one example of a molasses containing 49 per cent. of sugar, which treated by this process yielded a syrup containing 80 per cent. of sugar, of a coefficient of purity high enough for it to be added to the juice for defecation. There would be then a loss of only 20 per cent. of sugar.

At the general meeting of the sugar manufacturers of Germany in 1868, M. Dehu made an interesting communication relative to the practical application of this process. The principal difficulty was in the drying of the *mélassate*. Some judicious alterations made in the drying kiln have insured a regular dessication. The distillation of the washing water to recover the weak alcohol also presented some difficulties, which are now overcome. At Baden, Dr. Scheibler's process has been tried for the direct extraction of sugar from molasses. In this case great difficulties have been encountered, on account of the deposit of lime, which is produced by the treatment of the sucrate purified by water, always containing a considerable quantity of sucrate, from which sugar cannot be extracted by the ordinary methods. On the contrary, it has to be used at the defecation [of the juice]. It has, however, been possible to carry out the treatment of Dr. Scheibler on molasses in course of manufacture, so as to obtain the best results at the least possible expense. The return may in this manner be increased by 1½ per cent. over the ordinary method.

MM. Lair and Bilange have applied in the sugar manufactory of M. De Vivaise, at Anizy-le-Chateau (Aisne), a process founded on the preparation, or rather purification, of the same compound of lime and molasses obtained under the conditions specified by Dr. Scheibler. Only in place of having recourse to alcohol these gentlemen submit the *mélassate* to the osmotic purification. The fundamental idea of this process, osmotic purification, applied to sucrates of lime, has also been patented by MM. Boivin and Loiseau

"The phenomenon of diffusion, osmose, dialysis, &c., may be applied in the sugar factory, not only to saccharine solutions, but also to solutions in which sugar is combined in such a way as to form a scarcely soluble compound. MM. Boivin and Loiseau reserve the right to make this application, not only to their sucrate of hydro-carbonate, but further, to every kind of sucrate, and generally to precipitates slightly soluble, found in liquids saccharine or non-saccharine."—*Pat.*, No. 88,304.

Reading patents of this description we naturally inquire, on what proofs or experiments they are founded by their inventors. Thus regarding the sucrate of M. Rousseau, it is Dr. Stammer who has given the precise details of the discovery. This indefatigable *savant*, (whose works the sugar chemist meets with at every step of his researches,) studied and described most completely in 1867 the application of dialysis to the purification of sucrates. The following *resumé*, which I give as succinctly as possible, is from his work entitled "Osmose or Dialysis, and its Application to the Treatment of Molasses." I omit entirely any criticisms on M. Dubrunfaut's Osmose.

When molasses is submitted to diffusion with water the various constituent parts of the molasses are not diffused with equal speed; but this difference of diffusibility varies with the density of the liquids present, and is always very small. It is thus explained how Graham was able to draw theoretical conclusions contrary to the results obtained by applying the osmose to molasses. The mineral salts are the most diffusible, and the works of divers chemists have proved that these salts do not play in the formation of molasses the exclusive *rôle* attributed to them. If, then, the dialytic purification is real, it need only be so complete as to transform the molasses into pure syrups, and as we are able to carry out this purification with greater care, we shall certainly obtain better results. The principal difficulty consists in the fact that the dialysis of molasses abates as the density diminishes, and that the loss of sugar is so much the greater.

It is needful, then, to render the sugar less diffusible, by making the molasses into a compound itself only slightly diffusible. The studies of Dr. Stammer naturally led him to the trial of the dialytic action of water on sucrates of lime. As it was easy to previse, a considerable purification was obtained in this manner. As numerous experiments made in various ways always gave finally two saccharine solutions—the one containing the greater part of the sugar in such a state of purity that it might be extracted by simple concentration, the other contained the greater part of the mineral and organic salts, which together prevent the crystallization of the sugar.

These experiments were generally made in the following manner. The mixture of lime and molasses was separated by a leaf of parchment paper from the dialyser, either pure water, or lime water, or even milk of lime. The proportions of lime, of molasses and of water, as also the form and the disposition of the dialysing material. Below are some examples of the purifications produced.

The column M the apparent coefficients of purity, of the primitive molasses, R the coefficients of the purified molasses, and L those of the waters of exosmose.

No.	M	L	R	Loss of Sugar.
1	60	15·2	75	6·6 per cent. of the total sugar.
2	60·9	2-4-6-42	87	14 per cent. of the total sugar.
3	60·9	2-·3·5	80·6	Loss not indicated.
4	60·9	15·5	88·5	5 p. cent. of weight of molasses.
5	60·9	0 to 4	76·5	Loss nearly nil.
6	60·9	4-16-20-45	81·8-83	Loss not indicated.
7	60·9	10-17	80·4	6 per cent. of the total sugar,

THE NEXT BEET ROOT SEASON.

The Beet Root Season of 1872-73, for which our manufacturers are preparing now, is a very exceptional one, and recalls the year 1865, of happy memory, in its earliness and favourable conditions. The soil, which nothing has prevented the working and manuring at the proper time, is quite ready for the sowing of the beet, and in the north it has already commenced; this is 15 days in advance of ordinary seasons, which is considerable for the beet root.

All the news that we receive accord in the importance of sowing with corn, excited by the high price of cereals and oleaginous grain, too high in our opinion, which the cultivators obtain from the manufacturers. This is to the benefit of the agricultural interest *par excellence*, and in the actual course of the beet root, the cultivators have all the advantage of a participation in it without its inconveniences. In fact, the soil profits largely by the profits of the *usine*, and thus the sugar industry developes in close connection the agricultural and manufacturing interests of the country.

Thus, as we have said, there will be 20 to 25 new factories this year, most of which are in course of construction, and of which some like that of Cambrai will be equivalent even in the first year, to several old factories. On the other side, the supply of each *usine* will be rather above than below that of the past; and alcohol not encouraged by the price, nor by the pressure of the excise duties, will, if the position continues, be abandoned as a direct manufacture. We may expect that the next season's sugar crop will not be less than 350 or 400 millions of kilogrammes (350,000 to 400,000 tons). The consumption of France being only 275 or 280 millions of kilogrammes (275,000 to 280,000 tons), we know how necessary it will be to look for largely increased exportation.

The beet root progress is not less in Belgium, in Austria, and Germany, than in France; and it is no exaggeration to count this year on the erection in Europe of 100 new sugar factories able to produce at least 50 or 60 millions of kilogrammes (50 or 60,000 tons). Happily, the European consumption increases about 100 millions of kilogrammes annually (100,000 tons), and the foreign production does not make nearly the same progress.—*Journal des Fabricants de Sucre.*

BRITISH REFINERS AND THE SUGAR DUTIES.

The Memorial of the undersigned Sugar Refiners of London, Greenock, Liverpool, Bristol, Plymouth, and Manchester, to the Lords Commissioners of Her Majesty's Treasury, *Sheweth,*—

That the Sugar Refiners of the United Kingdom of Great Britain and Ireland, finding that the object of the International Convention of 1864 is no longer attained by the means then adopted, owing to the altered circumstances which now exist, have, at a General Meeting held in London, February 15th, 1872, deputed the undersigned, your Memorialists, to lay before you, in the following statement, their reasons for asking for a revision of the terms of the Convention, provision having been made for the same in Article 21 thereof.

The object of the Convention entered into by England, Belgium, France and Holland, in 1864, was to prevent a bounty being obtained from the revenue, in the exportation of refined sugar. To attain this object, raw sugar was classified according to its yield of refined sugar, and a scale of duties and drawbacks was based on this classification, the principle being that raw sugar shall be charged with an amount of duty, as nearly as possible in proportion to the quantity of actual sugar contained in it, so that the amount of duty returned on exportation of refined sugar shall be in proportion to the quantity produced from the raw material. This principle can only be carried out with accuracy, by ascertaining the amount of sugar contained in the raw material, and charging duty on that amount.

Your Memorialists are prepared to show that three departures from this principle are now in operation, the first arising from a defect inherent in a classified scale; the second from an incorrect classification of beetroot sugar; the third from appearance being not always an accurate test for the classification of such sugar.

A classified scale is only an approximation to accuracy, since it is evident that each class will embrace sugars containing more, and sugars containing less actual sugar than the quantity on which the duty for that class is calculated. The principle is, therefore, violated at the points of transition from class to class. When the duty is low, and the steps between the classes therefore small, this is of little moment; but when the duty is very high, the differences between the rates of duty on the various classes become magnified, and the incompleteness of the system of a classified scale is at once apparent. In 1864, the rates of duty in the four countries were tolerably similar in amount. Since then, the English duty has fallen, and the French risen, and now the French duty is five times as heavy as ours. The French refiners, therefore, now have, as compared with us, five times the inducement to select the best sugar of each class, since they gain by such selection, the large difference of duty which, when the duty is very high, exists between one class and another. These steps between the classes amount in France, to sums equal to about 1s. 8d., 2s. 1d., 2s. 6d., and 3s. 9d. per cwt., and in England, to 4d., 5d.. 6d., and 9d., at the present rates of duty in the two countries. The former amounts are quite sufficient to induce the French refiner to pay a premium on all the best sugar of each class, and thus secure a bounty approaching to those amounts. Therefore, with a very high duty, the graduated scale, even if the classification of the sugar be correct, does not prevent bounties from being obtained, unless the number of classes in the scale is increased to such an extent, as to reduce the steps between class and class to moderate dimensions. Twenty classes instead of four would be required to reduce the steps in the French scale, to the size of those of the English. Such an alteration would make the scale cumbersome and unmanageable.

2. In 1864, the classes were arranged, and the yield of each class established, according to the results of careful experiments made with all the various kinds of sugar then in use, but no experiments were made with beetroot sugar alone. Hence it has always been classified according to the standards used for other kinds of sugar. Since that time, the production of beet root sugar in France has doubled, and the greater part of the sugar duty in France is now derived from it. It is well known to contain more

pure sugar than is represented by its classification, and as every increase of one per cent. in the yield of sugar beyond the amount on which its duty is calculated, will give the French refiner, with the present high duty, a bounty of 3d. per cwt., it is easily seen, that if the yield of beetroot sugar, beyond what it is estimated at in its classification be, as is confidently believed, four or five per cent., a considerable bounty is obtained from that source, and is five times the bounty which we could obtain from the same source. This bounty could be reduced by lowering the standards by which beetroot sugar is classified, but the reverse has taken place. Special standards for beetroot sugar have recently been adopted, which are higher, instead of lower than those used for other sugar, and the bounty derived from the duty on beetroot sugar has thus been increased in the same proportion.

3. Another bounty to the refiner, and consequent detriment to the Revenue in the case of beetroot sugar, largest of course in the country where the duty is highest, arises from the fact that its quality is not indicated by its appearance in the same manner as that of cane. The Convention fixed *appearance* as the test for classification, but so little can beetroot sugar be judged by appearance, that it is not bought and sold by that test, but by analysis. A refiner may thus select a raw sugar low in colour. but rich in sugar, and thereby obtain a bounty. This also is a state of things not contemplated by the Convention, and opposed to its spirit and object.

In proposing International Refining in Bond and payment of duty on the products as the remedy for these evils, your Memorialists put aside the increase in the number of classes as impracticable, and the revision of the Standards as uncertain; and, reverting to the principle laid down by the Convention, they look for a means of accurately determining the quantity of sugar in the raw material.

Assessment of duty according to the analysis of the sugar would be a satisfactory solution of the difficulty if it were practicable; but the analysis which takes place in a refinery is a much more certain and practical method of arriving at the real quantity of sugar contained in the raw material, than a theoretical calculation based on chemical analysis. The system of refining sugar and paying duty on the products is really the same as paying duty on the raw sugar according to a classified scale *which has no intervals*, and which instead of being empirical is absolutely accurate, No one knows before it goes into the refinery exactly how much sugar can be got out of any given sample of raw sugar, nor how much treacle will be left behind, nor how much of the other substances which are neither sugar nor treacle will disappear; but when that sugar has once gone through the process of refining, the result is known to an ounce, its position in the duty-scale is established to a hair's breadth, and when the duty is paid on the sugar and treacle which are the results of its purification, no one is aggrieved. The Revenue receives and the Refiner pays neither more nor less duty than is just. If, instead of paying duty, the resulting sugar is exported, no bounty can possibly be derived from such a system of exportation.

Thus the principle adopted by the International Convention is carried out more thoroughly, and the object it had in view is attained more closely, by a method which gains, without failure, the same end by an improvement on the same means.

There are two minor advantages of this method. It will do away with the variety of systems of levying and collecting the duty which now exists in the several countries, and which was a great obstacle to the making of the Convention, and an equally great one to the proper carrying out of its terms. It will facilitate the introduction of raw material lower than that now embraced by the lowest class in the scale, which has hitherto been too heavily taxed in that class, and therefore virtually prohibited, while no lower class has been devised for it, owing to the difficulty of estimating its yield.

Your Memorialists think it due to the trade which they represent to explain that when the Convention was entered into they naturally looked only at the working of their own scale, and although the foreign duties were then rather higher than the English, there was not the startling difference which now exists. They were, and still are satisfied that, with the exception of the system now proposed, a classified scale is the nearest practicable approach to perfect equality for all classes of sugar, but they did not then contemplate the possibility of the duty in one country being five times as high as that in another. They were at that time, and still are, averse to the restraints of refining in bond, and they regard it now only as the lesser of two evils.

If the estimate made by your Memorialists of the bounties now gained in the country where the duty is highest be correct, the result must be that the sugar trade of the world will gradually centre in that country, which is now France. It is clear that the English consumer, though he might benefit during the process of change, would eventually be in the hands of a monopoly. The English Refiners would not be the only great sufferers; their troubles would be shared by all those connected with the industry, and they are not a few, since more than ten thousand tons of sugar a week are now refined for home consumption alone. The sugar merchant, also, though he may not care whether he sends sugar to France or England, would find only one market instead of several. Even the maker of raw sugar in France does not like the prospect of having none but French refiners for his buyers, and he has for some time been advocating the same course which is now proposed in this Memorial. This is very strong evidence in confirmation of the views of your Memorialists—evidence which may be found in the French newspapers, and in the recorded proceedings of the Central Committee of raw sugar manufacturers in France.

France, then, as represented by this very large class, extending as an industry over the whole of its northern departments, and carrying with it the agricultural interest, is in favour of the change which your Memorialists propose, and its government is anxious to increase in every possible way its revenue.

Your Memorialists believe that with regard to Belgium and Holland, the Governments of those countries will be glad to accept any plan within the spirit of the Convention, by which they can secure the full amount of the duty derivable from the sugar consumed in those countries.

Your Memorialists in conclusion, would venture to state that as the French Legislature is on the point of passing a law relative to its sugar duties, it is essential that any steps which might be taken for the purpose of calling a conference of the four powers, should be taken without delay.

Your Memorialists therefore pray that your Lordships will bring this matter at once before the French, Belgian, and Dutch governments.

A. W. Gadesden	*London.*
James Duncan	
George Martineau	
Robert Blair	*Greenock.*
John Neill, Junr.	
James Barrow	*Liverpool.*
Thos. O. Easton	
Conrad W. Finzel	*Bristol.*
Matthew Henry Hale	*Plymouth.*
Joseph B. Forster	*Manchester.*

Signed on behalf of the Memoralists,

A. W. Gadesden."

In consequence of the refusal of the Lords of the Treasury to grant the petition of the English refiners, Mr. Grieve, M.P., asked the following question of the Chancellor of the Exchequer in the House of Commons:—

"Mr. Grieve asked the Chancellor of the Exchequer if he would be good enough to inform the House whether he would accede to the request of the Sugar Refiners of London, Greenock, Liverpool, Bristol, Plymouth, Manchester, and invite the Governments of France, Holland, and Belgium to a conference, in order to a revision of the International Convention of 1864,—these Governments having signified their willingness to meet if asked by the Government of Great Britain."

"The Chancellor of the Exchequer: The question assumes that the Governments mentioned have signified their willingness to meet. This is obviously a point of great importance in connexion with the subject; and until it is cleared up, it would not, I think, be advisable to answer the question."

The facts in reference to this matter are stated in the following document issued by British refiners:—

"Important Question about the International Convention of 1864, to be asked by Mr. Grieve on Monday Evening.

"The following are the facts:—

"A meeting of the sugar refiners of Great Britain and Ireland was held on Thursday, February 15th, at which it was resolved that, owing to the International Convention of 1864, between England, France, Belgium, and Holland, having become inoperative, efforts should be made to procure its revision, and a Committee was appointed for that purpose.

"This Committee, after appointing four of its members as delegates to represent the views of the British refiners in France, Belgium, and Holland, and to ascertain the feeling of the sugar manufacturers, refiners, and Governments of those countries, applied to Mr. Gladstone for an audience. This was granted on Tuesday, February 20th, when the case was stated to him as follows:—

"The object of the Convention is the suppression of bounties on exportation of refined sugar in the four countries, and the system adopted for attaining it is a classified scale of duties. This system only partially carries out the principle on which it is based.

"Owing to altered conditions caused by a great rise in the duty in one country, and a reduction in another, this system has become ineffectual, and the difficulty has been further aggravated by the great increase in the production of beetroot sugar, which is incorrectly classified, and is valued according to analysis and not by appearance. The same principle can be carried out completely, and the object of the Convention attained, by substituting for the classified scale, an International system of refining in bond, and the payment of one duty on all sugar going into consumption. If this system is not adopted, the large bounties now obtained in France on the exportation of refined sugar will eventually place the British consumer in the hands of a French monopoly.

"The Committee concluded with a request that the Conference of the four contracting powers might be at once called to consider this matter, and were asked by Mr. Gladstone to put their statement into the form of a memorial to the Treasury.

"This was at once done, and the memorial was presented on Saturday, 24th February.

"In the meantime the delegates abroad had interviews with the Central Committee of the sugar manufacturers of France, the sugar refiners of Holland, and the sugar manufacturers of Belgium, and found in all those bodies a strong feeling in favour of the change proposed. They had also interviews with the Finance Ministers of each of those countries, and found in each case that the Government was ready to agree to a Conference, if requested by England. These facts, together with documents substantiating them, were at once communicated to the Lords of the Treasury as supplementary to the memorial, and a note was likewise added pointing out circumstances connected with the present statistics of the sugar trade, and also calling attention to the fact that the Committee of the House of Commons which examined the question of the sugar duties in 1862, while unable, for reasons which have now been removed, to recommend the system now proposed, was convinced of its theoretical perfection.

"It was represented to the Lords of the Treasury at the conclusion of the memorial, and several times repeated previous to the receipt of their answer, that the case was urgent owing to a new law on the sugar duties being on the point of presentation to the National Assembly in France.

"On the 20th March an answer was returned stating, without giving reasons, that, after a careful consideration of the statements contained in the memorial, the Lords of the Treasury were unable to recommend compliance with its request.

"The memorialists are naturally anxious to ascertain the difficulties which have led to this decision in order that they may, if possible, endeavour to remove them.

"To this end Mr. Grieve has given notice of his intention to put a question on Monday night to the Chancellor of the Exchequer, and in case discussion may hereafter take place upon the subject, it is hoped that this short statement of the facts may enable you to form a judgment upon its merits.

"A copy of the memorial has been forwarded."

There is an aspect of this question to which we would invite the attention of all finance ministers, and we think it may modify Mr. Lowe's view of the matter. So long as European Governments consider sugar a valuable source of revenue, that value will be enhanced by any arrangement under which chancellors of the exchequer may be enabled to look at it purely from a financial point of view, without having to fear complications in trade as a result of their operations. So long as sugar is grown in Europe, the sugar trade must be an important *international* trade, and, since duties levied upon it necessitate drawbacks on exportation in order to make the trade perfectly free, it is quite clear that the remedy, which will enable chancellors of the exchequer to treat sugar with ease, and in reference *only* to the amount they desire to raise, must be international also. It may be said that an English Chancellor of the Exchequer must not complain if a foreign country chooses to give its refiners bounties on export, since the English public reap the benefit; but the political economy involved in this notion is very shallow. Supposing that the bounty given by a foreign government should only be sufficient (and it is never more than this) to lower the prices of refined sugar to a point at which home refineries must be closed or ruined, the cheap sugar will only be obtained by the English public *temporarily*, since prices must then rise, and the bounty flow back as rapidly, if not much more so, into the pockets of the foreign refiner, until English refiners are able to recover themselves and assist in supplying the market. The price of sugar depends on the supply ultimately, and not on presents made by countries to each other in the shape of bounties taken from the pockets of the taxpayers. These bounties disturb free trade, and tend not only to make refining impossible in those countries to which the bounties are sent, but they also, in monopolizing the refining trade of the country, giving its refiners bounties, discourage the grower of sugar by circumscribing the market for his produce, and consequently they reduce the supply.

An agreement between European producing and refining countries, providing for international refining in bond, and payment of the duty on sugar as it passes into immediate consumption is the remedy proposed for the evils which are at present so seriously injuring the sugar trade of Europe.

Were the countries, parties to the Sugar Convention, to agree to this proposal, there would be an end of the question, and chancellors of exchequer would then be able to raise or lower or abolish the duties on sugar without material disturbance to the free trade which it is the public interest to secure, and without having to think of anything but the amount they may wish to raise from the sugar duties. As things are at present, they find their operations made very difficult by the many other considerations the question demands; and it is this circumstance, and not the wish of the French Government to support French refiners at the public expense, which is now a difficulty in the way of French financial ministers, who find that in proportion as they raise the duty, the facilities are increased for legitimate fraud on the revenue.

The growers suffer and are dissatisfied, as the French refiners gain; and until our Government takes a common sense view of the matter, reduced production of the raw material and enhanced scarcity of grocery for the consumer will be the result.

It is as much a national question as it is a refiner's, and we trust Parliament will see that it is not to be trifled with in deference to the theory of the objectionable character of all commercial treaties.

The sugar refiners of England do not ask for *protection*, they do not seek to be supported at the public expense; what they say is, that if sugar is to be taxed it must be arranged that the method of taxation shall not interfere with free trade in sugar; and so long as this is their petition, it must follow that their interests and those of the public are identical.

CHEMICAL MANURES.

Some of the readers of *The Sugar Cane* being interested in the cultivation of the beet root, we translate the following passage, containing both the old and new compositions of manure, from a new edition of Mr. Georges Ville's work on chemical manures:—

"The beet root is a culture so important, and one with which so many and varied interests are connected, that all proceedings with regard to it must be taken with extreme care.

"The complete manure, No. 2, is become in some degree classical, so numerous and incontestable are the proofs of success which have been achieved by the use of this formula:

Old Formula.

Complete Manure No. 2,	1200 k.	per hectare,	about	1070 lb.	per acre
Acid phosphate of lime	400 „	„	„	357 „	„
Nitrate of potash	200 „	„	„	178 „	„
Nitrate of soda......	300 „	„	„	267½	„
Sulphate of lime	300 „	„	„	267½	„
	1200 k.	per hectare,	about	1070 lb.	per acre

New Formula.

Complete Manure No. 2,	1200 k.	per hectare,	about	1070 lb.	per acre
Acid phosphate of lime..	400 „	„	„	357 „	„
Chloride of potassium ..	200 „	„	„	178 „	„
Sulphate of ammonia ..	140 „	„	„	124½	„
Nitrate of soda........	300 „	„	„	267½	„
Sulphate of lime	160 „	„	„	143	„
	1200 k.	per hectare,	about	1070 lb.	per acre.

"These manures differ in two points: the price and the composition.

"The one contains nitrate of potash, the other a mixture of sulphate of ammonia and chloride of potassium.

"There is a saving in the price of the latter of 33 fr. per hectare (about 11s. per acre).

"In what cases the substitution should be made, in what others it will be better that a simple comparative trial should be made first, I will briefly show.

"In the production of the beet root three things have to be considered—

"1st. The yield of the crop.

"2nd. The saccharine richness of the root.

"3rd. Its destination.

"With regard to the yield and to the saccharine richness, the manure of the latter formula will be as efficacious as the former, if not more so. Consequently, if the beet root is intended for the feeding of cattle or for the distillery, the latter being cheaper is to be preferred.

"When the beet root is intended for the production of sugar other things have to be considered. Universal experience in manufacture has long shown:

"1st. That raw sugar which contains a large quantity of saline matters produces more molasses in the refinery, and renders less sugar crystallizable, than sugar which contains only a small amount of salts.

"2nd. That beet roots grown on saline soils, or obtained by certain manures, yield juice difficult to work and unprofitable; this is, it is said, because of the great quantity of salts which they contain.

"3. That of all the salts, the alkaline chlorides, and especially the chloride of sodium, are decidedly the most injurious.

"On the other hand, in an experiment on a large scale made in Poland with the No. 2 manure of the new formula, beet roots of perfect quality were produced. In Germany the use of chloride of potassium is general and is found very beneficial.

"In the presence of contradictory affirmations, what are we to conclude? Must the use of chloride of potassium be proscribed even in a moderate quantity, or must its use be advised? It does not follow because that beet roots grown in saline soil produce bad juice that the use of the chloride of potassium should be proscribed. Two effects are possible. When the quantity used is small, 200 or 300 kilog. to the hectare, the salt is assimilated. It is fixed in the tissues and remains in the pulp, and the juice is of good quality. When a large quantity is used, part of the salt passes into the juice and is injurious in the manufacture.

"In conclusion, I have no hesitation in recommending the use of the new compound when the beets are for feeding cattle or for the distillery. When the beets are intended for the manufacture of sugar, I recommend the old No. 2 manure; but I advise trial of the new No. 2, that sugar manufacturers may have an opportunity of testing the qualities of the beets grown with it."

PROCESS OF DEFECATION IN DEMERARA.

Some weeks ago a cotemporary directed attention to some samples of sugar of very fine quality, from Demerara, in the possession of Mr. H. T. Chamberlain, of Bristol, which were said to have been purified by an entirely new process, viz., by the use of bichromate of lime instead of animal charcoal. This appeared to be a new discovery, especially so as bichromate of lime is not an article of manufacture, but as might have been supposed, the word bichromate was used by mistake for bisulphite of lime, which has been employed as a defecant for years past in Demerara, as well as in Australia and some other places.—See *The Sugar Cane*, No. 22, page 264.—ED. *S. C.*

DEMERARA.

EXPORTS FOR THE YEAR 1871.--The Comptroller of Customs report for the year ending 31st December last shows that the quantity of sugar exported in hogsheads during that period to the United Kingdom was 45,031; to the United States, 55,168; to the British Provinces, 3,497, and to other countries 614, making a total of 104,310 hhds. The quantity of rum exported to the United Kingdom was 26,894 puncheons; to the United States, 46; to the British Provinces 1,446; and to other countries 1,316, making a total of 29,702 puncheons. 1,037 casks of molasses were exported to the United Kingdom, 7,329 to the United States, 4,947 to the British Provinces, and 1,201 to other countries, making a total of 14,514.

There was 4,259 cubic feet of timber shipped to the United Kingdom, and to other countries 18,331, making a total of 62,590 cubic feet, 39 bales and 5 bags cotton, 9,026,675 shingles, 34,412 barrels of charcoal, and 1,632,718 cocoanuts were exported.

MAURITIUS.

The following paragraphs on the state and prospects of the Island of Mauritius are from the *Commercial Gazette* :—

"Dependent as we are on our commercial relations, as our agricultural produce must find a market beyond the colony to pay for our food and all our other wants, we cannot help alluding at some length to the agricultural and commercial prospects of the island. Notwithstanding the intelligent efforts making, from one cause or another, we cannot bring our production up to its former level. Whilst cultivation has been extending in the interior of the island estates on the sea side have been abandoned ; the land left on the one hand is greater than that brought into cultivation on the other ; the canes are not so productive as they were owing to the artificial means employed in cultivating the soil that has borne the same plant for a length of time. There is no doubt we are changing our climate by laying the island bare and destroying the forests in the higher lands. The mistaken notion that the quantity of rain that falls over the surface of the island has diminished is being exploded by the test of facts, and it is to be regretted that the careful surveys made with a view to an essay of irrigation from the Mare aux Vacoas has not met with sufficient encouragement from those who were to profit by it. Irrigation will not change the climate as would the rewooding of the higher parts of the island ; it would, however, render thousands of acres fertile that are now out of cultivation. If the present favourable season continues, we fear we shall not see the question again agitated for some months, but we are happy to learn that its importance is duly appreciated by gentlemen in London who are interested in our welfare and progress.

"The quantity of sugar produced in the last ten crops is as follows:—

	Tons.	Tons.
1862-63	158,000	
1863-64	121,000	
1864-65	129,000	
1865-66	129,000	
1866-67	106,000	
		634,000
1867-68	116,000	
1868-69	78,000	
1869-70	132,000	
1870-71	90,000	
1871-72	115,000	
		531,000

"Average in the first five years, 127,000 tons; in the second, five years, 106,000 tons. Fortunately for the colony the value of our produce has been higher, and thanks to modern science, including the Hon. E. Icery's discovery, and the energy of our sugar makers the quality has been very superior in the last three years. Whether high prices will continue is a doubtful question when we see the efforts making to produce sugar in temperate as well as in tropical countries. At all events, the further we go the more our intelligence is put to the test to reduce the cost and increase the quantity of production. We have been changing the plant by introducing a variety of new species, we have been using largely of guano and are now beginning to find excellent substitutes; it remains for us to devise means to secure some portion of the water that falls in abundance in the higher parts of the island for the irrigation of plantations. To show that the quantity of rain, whilst it varies, does not materially diminish it in the aggregate, we give a note of the yearly fall at a certain distance in the interior, some 1400 feet above the level of the sea:—

	In.		In.
1866	65·67	1869	88·00
1867	94·91	1870	95·96
1868	143·47	1871	90·00
	304·05		273·96

"Other industries besides sugar production have made some slight progress. Sericiculture, thanks to Mr. C. Descroizilles, is making some progress. Mr. D. has proved that the silk produced here is of superior quality, and through his persevering efforts we may hope to see the quantity increased. The aloes fibre has now become an article of commerce, a certain quantity being prepared and exported by Mr. Lesidaner and others. The rum distilling industry cannot be said to be in a prosperous condition. The quality of rum made is so inferior that it is not worth exporting. The distillers from time to time have recourse to a combination to raise the price, but this artificial system does not last long, nor do we think it should in the interest of the industry as well as the public revenue.

"The Botanical Gardens have been made very useful. The numerous varieties of canes introduced from New Caledonia have been propagated there under the intelligent and indefatigable director, Mr. Horne, and in the course of the year upwards of 100,000 cane tops for planting have been distributed. It is now ascertained that there are from 30 to 40 of these canes that are of good varieties and thrive well here, and great services have thus been rendered to agriculture. We must not forget that it was Sir H. Barkly who readily consented to the request of the Chamber of Agriculture and first sent Dr. Meller to collect canes in the different cane growing countries. The gardens at Pamplemousses are in excellent order and a number of new plants have been introduced. Mr. Horne has besides been engaged in laying out the new gardens at Curepipe, in cultivating cinchona there and in planting native forest trees in the eastern slope of the Trou aux Cerfs, which are thriving well. This year bark will be produced from the cinchona plants and the quality of the quinine, it is expected, will be good."

Correspondence.

To the Editor of The Sugar Cane.

Sir,

The tone of the letter of your intelligent correspondent V, evidently shows a personal interest in the many questions involved in the production of sugar, and his familiarity with the distinctive features of the common process of manufacture, testify to his ability so far to discuss their merits. I regret to be informed that V is not disposed to look on my figures with complacency. Possibly he is disposed to believe, with many more, that expensive appliances complete the desired perfection of an important and valuable manufacture. I am aware that loss has been supposed to be completely guarded against, by superior economy of manufacture, and by the use of those appliances of perfection which modern mechanical invention has afforded. However that may be, I find that my statistics are supposed to deserve the indifference, at best, of your correspondent, who tells us, they are "somewhat loosely compiled;" but when he uses the word "unjust," in relation to my conclusions, his position claims my attention. I am aware I based my statistics on the Government returns of 1867. I took the weight of a hogshead of sugar on shipment as 1 ton, which is about the weight given in a letter to *The Sugar Cane*, Jan., 1872, p. 44. Now whatever improved processes have been carried out in Demerara since 1867, we know that in many of the Islands of the West Indies there has hitherto been but little improvement in this respect, and that the drainage is as great if not greater than at that period. Thus a recently written letter contains the following:—"I have ten estates in Jamaica, and on some of them 1,300 gallons of juice produce 20 cwt. of sugar. This sugar is kept to drain during four or five weeks, and, on being removed, commences again to leak; and although weighing 20 cwt. before shipment, it only weighs on an average 17 cwt. when landed in London. It drains off from 10 to 15 per cent. in the house."

Here we get at once what appears to be the common weight of a newly filled hogshead of sugar, for the definite weight is specified twice in these few lines, as the repeated aim at a standard weight might reasonably be. We see that the hogshead "drains off" 10 to 15, say 12·5 per cent. on this 20 cwt. =2·5 cwt. Now it is pretty evident that this loss of 2½ cwt. by "drainage in the house," is made up by a corresponding weight of already drained sugar from stock. Indeed, we are told that the hogshead "weighs 20 cwt. before shipment;" else the cask held, primarily, 22½ cwt. at least. So then we have about the same loss in figures, not assumed, that I estimated on Demerara and Barbadoes sugars.

I think it was Derosne who told the Cubans that "the abundance of molasses was only the result of a modification of the sugar, rendered uncrystallizable by the vicious processes employed in its manufacture." In point of fact, the mere presence of molasses is an evidence of impurity, and of imperfection of manufacture; and the quantity of molasses indicates the exact distance we are from perfection, and also the loss which the owner of the plantation suffers.

To direct attention to this loss, and to the fact that defecation may be more complete, that impurities of cane-juice, which are so inimical to success, and the direct cause of loss, may be economically separated, without destroying contained sugar, or involving even the possibility of contaminating the product, has been the object of much of my correspondence with your magazine. I have had no desire to be unjust to the planters either of Demerara or any other colony.

In conclusion, I desire to appreciate fully V's polite consideration for my "inadvertent" stumbling on a geographic blunder, when evidently absorbed on a totally different subject.

I remain, yours obediently,

W. Eathorne Gill.

46, *Mortimer Road, DeBeauvoir Square,*
London, N.

FRENCH PATENTS.

(*From La Sucrerie Indigène.*)

88727. M. M. Lebaudy Freres, Refiners, Paris. *Process for the Purification of Sugars.*

There are utilised, say the inventors, for the purification of saccharine juices, sulphuric acid, lime, carbonic acid and lime, sucrate of hydrocarbonate of lime, salts of lead, of zinc, of magnesia, &c.

The purifying agent which they reserve for their use in the present patent is the carbonate of lime hydrated, that is to say, obtained by combination with carbonic acid and of lime in the presence of sugar (*Pelouze*), or by other means which these gentlemen keep to themselves.

They add the carbonate of lime hydrated to the sugar liquids (juice of the manufactory or syrup of the refinery) alkaline, or previously rendered so. The liquids may be more or less dense. The temperature is raised and the carbonate of lime is precipitated with the impurities. The results obtained are superior to those given by any other method.

These gentlemen have proved by experiment that many species of carbonate of lime hydrated may be formed. They do not retain any specially: on the contrary they reserve in a general way as a purifying agent the use of every carbonate of lime formed in chemical combination with water, whatever may be the proportions of carbonate and of water and the means employed to obtain it.

88,728 M. Lisse. *Process of Extractng the Sugar contained in Molasses.*

The process of M. Lisse consists in making the drainage from the centrifugals submit to a calco-carbonic treatment analagous to that employed with ordinary juice.

M. Lisse operates in the following manner on syrups drained from sugars of the first crystallization, otherwise called the seconds.

On running from the centrifugal they are raised by a *monte-jus* into a cistern where they are diluted with water so as to reduce them to a density of 24° Baumé. From thence the syrups return into the copper to be carbonated. After the addition of milk of lime (the inventor does not say whether this addition is made in the cistern or in the carbonating copper) he introduces a current of carbonic acid up to the point when the syrups become slightly alkaline. He then raises the temperature to the boiling point, and afterwards decants the syrup, and then passes the clear part thus obtained on to charcoal filters.

The filtered syrups are boiled to grain in the apparatus and produce *masses-cuites*, which may at once be centrifugaled, like the *masses-cuites* of sugars of the first crystals.

He subjects the drainage from the seconds to a similar course of treatment, that is to say, the third syrups, and he says that a mixture of the second and third syrups may be operated on in the same manner.

The proportions employed are 1600 to 1800 litres of syrup diluted to 24° Baumé, to 40 litres of lime at 22° Baumé.

The most convenient temperature for carbonating is that of 60° C. (140 Faht.) the heat of the syrups on issuing from the centrifugal.

When the syrups are heavy, M. Lisse adds 10 litres of fine char, in the carbonating copper, and 8 litres of milk of lime into the boiling copper, and thus improves the quality and colour of his products.

We understand that the process of M. Lisse applies specially to the products evaporated and boiled to grain in the vacuum.

The inventor professes that he can produce seconds sugar of the colour of No. 15, and of a standard of nearly 95°.

In a certificate of addition to the principal patent, M. Lisse appears to allow that the practical results of his process are not so brilliant as he had hoped, and he throws himself on to a combination of osmose with his process, that is to say, to the calco-carbonic purification he joins the osmotic purification, which he employs either alone or in conjunction with the first for the same syrups. Thus he treats his seconds by osmose, which lowers it to 22° Baumé, and he then boils it to proof.

The thirds, draining from the second crystals, may still be treated by osmose, then mixed with lime, carbonated, heated, decanted, filtered, and finally boiled to proof.

The ordinary means may equally be applied to the seconds, and only apply this process to the thirds.

The quantity of lime is not very precise; it varies according to the nature of the syrup.

In short, the certificate of addition appears rather to restrain than to extend the process described in the principal patent, and to throw some doubt on the efficacy and its industrial value.

HAVANNA AND MATANZAS.

Exports from the 1st of January to the 3rd of February.

(From Licht's Monthly Circular.)

	1872. Tons.	1871. Tons.	1870. Tons.
To United States of America	14,615	10,986	14,954
,, Great Britain	595	900	6,434
,, Northern Europe............	384	300	1,020
,, France	....	212	1,814
,, Spain......................	194	172	4,055
,, Southern Europe............	....	....	....
,, Other Countries	91	114	129
Total......	15,879	12,684	28,406
Stocks in Havanna and Matanzas ..	19,557	24,316	63,829

MAURITIUS.

Exports from 1st August to 11th January.

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
To England..........	25,683	9,317	22,431
,, France	13,075	3,566	8,861
,, Australia	15,142	19,544	22,424
,, Bombay..........	22,600	12,878	20,863
,, New Zealand......	1,987	1,717	3,123
,, Cape of Good Hope..	556	1,407	863
,, Other Countries ..	2,334	195	662
Total..........	81,377	48,624	79,227

ESTIMATED PRODUCTION OF THE PRESENT BEET-ROOT CROP OF SUGAR COMPARED WITH THE TWO PREVIOUS SEASONS.

(From Licht's Monthly Circular.)

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
France	315,000	289,083	289,324
Germany (Zollverein)	190,000	262,986	217,192
Austro-Hungary	170,000	182,280	151,354
Russia and Poland	90,000	135,000	132,500
Belgium	55,000	55,739	43,552
Holland and other countries	25,000	17,500	12,500
Total	845,000	942,588	848,422

STOCKS OF SUGAR IN THE CHIEF MARKETS OF THE WORLD ON THE 1ST FEBRUARY, IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	1872.	1871.	1870.
United Kingdom	104	115	103
France	68	140	139
Germany (Zollverein)	35	44	44
Holland	34	21	24
Six other depôts	4	4	3
	245	324	313
United States	46	40	77
Havanna & Matanzas	20	24	64
TOTAL	311	398	354

CONSUMPTION OF SUGAR IN EUROPE AND THE UNITED STATES, FOR THE YEARS ENDING 31ST JANUARY, IN THOUSANDS OF TONS.

	1872.	1871.	1870.
United Kingdom	689	702	641
France	377	315	311
Germany (Zollverein)	232	214	225
Holland	22	29	31
Six other Countries	118	90	112
	1,438	1,350	1,320
United States (Imported)	544	475	424
TOTAL	1,982	1,825	1,744

SUGAR STATISTICS—GREAT BRITAIN.

To 16th March, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	5	1	1	4	12	13	7	2	2	6	17	20	14	1	2	9	26	32
British East India	3	1	..	..	4	14	3	1	..	..	3	3	3	3	..	..	6	5
Mauritius	4	1	1	3	8	4	6	2	6	4	18	4	5	1	6	4	16	3
Cuba	2	1	..	3	6	3	..	1	1	..	2	3	2	..	2	2	6	12
Porto Rico, &c. ..	1	2	..	..	3	3	..	2	..	..	2	2	1	2	..	..	2	5
Manilla & Java ..	14	8	1	4	26	35	9	4	2	5	19	9	7	5	1	2	15	15
Brazil	1	11	1	6	18	13	1	11	2	4	18	12	1	8	2	4	14	15
Beetroot, &c.	8	1	1	7	18	14	7	5	3	24	39	37	5	6	3	24	38	38
Total, 1872 ..	37	26	5	28	96	100	33	27	16	43	119	90	37	27	15	45	124	126
Total, 1871 ..	54	27	6	13	4 decrease		29	21	11	30	29 increase		44	27	11	44	2 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

The raw sugar markets have shown a little improvement for some weeks past, consequent on there being a better demand for refined produce, but there has been no material improvement in the relative values of raw and refined. Prices are a little better than a month ago; No. 12 Havana afloat is quoted at 29s. 3d. to 29s. 9d., and Cuba muscovado is worth 26s. 9d. to 27s. 3d., being about 9d. per cwt. for both descriptions above quotations twelve months ago. Middling to good Bahias are 23s. 6d. to 24s. 6d., and good to fine brown Pernambucos 24s. 6d. to 25s. 6d., the same figures as were quoted for them at this date in 1871. The average duty paid price of refining qualities of British West India is 31s. per cwt., and common brown lumps are quoted at 40s. 6d. to 41s. in London.

Imports since the opening of the year continue to appear in excess. At the four ports 119,000 tons have entered, compared with 90,000 tons to the same period last year. Stocks show a deficiency of 4,000 tons to this date, and deliveries have fallen off to the extent of 2,000 tons.

Late accounts of the present crop from Cuba are not very encouraging, and it is reported in some quarters that not only will the season continue to be very backward in that island, but some fears are expressed that the yield will scarcely prove much in excess of the very deficient crop of last year. Accounts from other parts do not promise such increased production as will supply the certain falling off in the beet sugar crop, and the possible deficiency in Cuba

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SUGAR CANE.

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☞ The writers alone are responsible for their statements.

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THE ALKALINE TREATMENT AND THE GLUCOSE IMPURITY.

By M. Eugene Feltz,

Arlovetz, Russia.

Glucose constitutes one of those impurities to which the attention of sugar chemists have been particularly drawn. The product of the beet root contains only very small quantities of glucose, but the refiner and the manufacturer of cane sugar have continually to struggle against it.

Many chemists, and M. Dubrunfaut especially, have drawn the attention of refiners to the dangers of this impurity, and the chief advantage of the alkaline treatment in refineries will be the destruction of the glucose. This treatment generally adopted in the manufacture of beet sugar has not found favour in the colonies, where the most enlightened planters completely ignore it. When glucose is destroyed by alkalies a deep coloured compound is produced; on the other hand, heat applied to a mixture of glucose and sugar causes part of the latter to become uncrystallizable. Of the two evils, the colonial planter chooses what he considers the least: he transforms a part of his sugar into glucose rather than manufacture sugars of inferior colour. This choice was perhaps justifiable when sugars were sold entirely by colour, but it is only reasonable that the subject should be reconsidered in view of the modification introduced by the purchase of sugars according to chemical analysis.

The establishment of great central factories provided with the most perfect machinery, which constitutes one of the greatest advantages of the beet sugar manufacture over that of the colonies, has given a new impulse to the manufacture of sugar from the cane. Those methods of purification which depend on the use of large quantities of lime, and which are employed so successfully in the treatment of beet juice, have been tried again and again without the various processes appearing to give practical results.

For an account of the reasons which led colonial manufacturers to reject the alkaline methods, an excellent treatise published three or four years ago by Dr. Icery, may be read with profit.*

M. Peligot in some of his works endeavoured to prove that glucose did not exist in fresh cane in its normal state. M. Icery after numerous analyses arrived at an opposite conclusion: that glucose is a normal product of the cane, which always contains it, in quantities which vary with the part examined and with the period of the development of the plant. Small, in cane grown in good soil and under favourable climatic conditions, the proportion of glucose increases sometimes up to 40 per cent. of the total saccharine matter. M. Icery strongly insists on the dangerous properties of glucose, which he considers as the stumbling stone of the colonial manufacture:—"The organic impurities may be eliminated or rendered inert by energetic defecation, whilst the transformation of glucose into its calcic derivatives deeply colours the syrups, and renders the sugars dark and viscous." In a word, according to M. Icery, "the remedy is worse than the disease."

Even in the case of excellent juice containing only traces of glucose, the alkaline treatment produced dark coloured sugars. In consequence, the general rule followed in the manufacture of colonial sugar is to maintain through all the various operations an acidity sufficient to produce brilliant sugar, and to prevent by gradual neutralization the too great transformation of sugar into glucose.

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* Paris: Challamel aîné.—A complete translation of this work appeared in the organ of the Colonial Sugar Industry, *The Sugar Cane*, towards the end of the year 1869.—E. F.

Of late years, in a number of manufactories, the defecation by lime has been replaced by a treatment with sulphite of soda or sulphite of lime. M. M. Pérrier Possoz prescribe the neutral sulphite of soda; they employ one kilogr. of dry sulphite to 1,000 litres of juice= 1 lb. sulphite to 100 gals. juice,—and obtain the neutralization by the addition of milk of lime. Care is necessary to avoid rendering the juice alkaline. M. Icery still further insists on the necessity of not rendering the juice *completely* neutral. An essential condition of the employment of his monosulphite of lime process is the preservation of the natural acidity of the juice. Even a momentary neutralization would be sufficient partially to paralyze the advantages of the process. The acidity naturally increases with the concentration of the liquid, but it may be prevented from becoming too acid by small quantities of lime.

We see that the prescriptions of the inventors of the sulphite processes have not altered the opinion of the cane sugar manufacturers on the alkaline treatment. Messrs. Icery and Possoz are too able chemists to be accused of mere fidelity to routine. It is more reasonable to admit that the treatment of glucosic juices and syrups presents some difficulties that have not yet been studied with sufficient care. From this, doubtless, proceeds the radical difference with which the subject is regarded in Europe and in the colonies.

It may be interesting to repeat some of the important experiments which led to the admission or rejection of the alkaline treatment in the manufactories or refineries of glucosic sugars. Before relating these experiments it will be useful briefly to recall the results of a work of great length, published by H. Reichardt*, on the transformations which glucose undergoes in the presence of alkalies.

A great number of chemists have turned their attention to these reactions since the first works of Lowitz, which date from 1792. The works of Peligot are classics. Kawalier and Mulder again took up this study at a more recent period. Dr. H. Reichardt has studied the action of baryta on glucose, in consequence of the facility which the estimate of this base presented.

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* Zeitschrift des Vereins für Rubenzuckerindustrie. 1870. c. xx., pp. 529, 545.

When a solution of glucose containing baryta is heated, the liquid becomes brown and very turbid. We may thus obtain on the filter an abundant brown precipitate. This is a salt of baryta which contains a new acid, saccharic acid, "saccharum salure." This acid was discovered and separated by H. Reichardt; it reduces copper solution. The salts of soda and potash are soluble; the salts of lime less so.

In the filtered liquid glucic acid is found with one part of saccharic acid. Glucic acid, so long known, has been isolated by M. Reichardt, and its properties better determined. It is not coloured, but becomes brown under the influence of a rather high temperature. The glucates of potash, of soda, and of lime are soluble. Glucic acid reduces the copper solution.

This acid is decomposed with great facility, and it is impossible to concentrate it or its combinations with alkalies; what is formed is apoglucic acid. This last acid does not reduce the copper solution.

When a solution of glucose is treated by lime, at a high temperature, the same reactions are produced. If the solution contains a small proportion of glucose it becomes brown without becoming turbid; but if it contains much, a brown precipitate is easily separated. The combinations of lime with saccharic acid are less soluble than the glucate of lime.

The presence of glucose in the juice causes or facilitates fermentation, thus glucosic impurities may in this respect be very injurious. This is a fact which has been often proved; we will then only consider in the following experiments the direct action of glucose in transforming sugar proper into sugar uncrystallizable under the influence of heat.

The experiments were made with a syrup of sugar inverted by means of a small quantity of sulphuric acid, afterwards neutralized by chalk. The inverted sugar thus obtained was always rather coloured, and very soon showed a slightly acid reaction. Some of the experiments were repeated with a solution of dextro-glucose placed in some inverted syrup and purified by several alcoholic crystallizations.

Experiment I.

A saccharine solution, containing in 100 cubic centimeters 15 grms. of crystallizable sugar and 2·21 grms. of inverted sugar, was maintained at a temperature of 70° to 75° Cent. (about 160° Faht.)

In 8 hours it contained 2·64 grms. of inverted sugar.
In 24 ,, ,, 6·41 ,, ,, ,,
In 48 ,, ,, 10·10 ,, ,, ,,

Experiment II.

100 cubic centimeters of the same solution was kept at the boiling point. The solution contained

At the end of 6 hours 10·09 grms. of inverted sugar.
,, 18 ,, all the sugar was inverted.

Experiment III.

A solution containing 15 grammes of crystallizable sugar and 1·86 grm. of glucose, was kept at a temperature of 70° to 75° Cent. (average about 162° Faht.)

It contained in 6 hours 1·95 grms. of uncrystallizable.
,, 16 ,, 2·12 ,, ,,
,, 40 ,, 4·59 ,, ,,

The same solution kept at the boiling point contained 9 grammes of uncrystallizable sugar after 8 hours, and the whole had become inverted in 20 hours.

In the above experiments the acidity was very weak; stronger, however, in the solutions kept at boiling point.

Experiment IV.

To estimate the quantity of acid produced by the transformation of glucose by heat, a solution of inverted sugar in water was maintained at boiling point.

A solution containing 6·94 grammes of inverted sugar in 100 c.c., kept for 40 hours at the boiling point, still showed 6·94 grammes inverted sugar, but it had acquired an acidity corresponding to 0·0215 of lime (CaO) per 100 c.c. Thus very small quantities of lime suffice to neutralize the acidity, but neutralized in this manner the acidity soon reappears, as shown in

Experiment V.

A solution containing 15 grms. of sugar and 4·13 grms. of inverted sugar, was rendered alkaline by a little lime and kept at boiling point. At the end of 4 hours the liquid had become slightly acid; after 7 hours it contained 5·04, and in 24 hours 11·21 grms. of uncrystallizable sugar.

Experiment VI.

In this experiment sufficient lime was added to destroy half the glucose contained in the original solution. After being boiled a short time the liquid, at first strongly alkaline, had become neutral, and at the end of 5 hours slightly acid.

The same sugar solution was treated by an excess of lime, afterwards precipitated by carbonic acid; the solution now nearly black, was kept boiling for 24 hours, and was still slightly alkaline.

Experiment VII.

A solution of refined sugar containing inappreciable traces of inverted sugar, was kept at the boiling point. At the end of 12 hours the solution, now become slightly yellow, contained 3·04 grms. of inverted sugar. At the end of 36 hours it was quite acid, and all the sugar had become inverted.

Experiment VIII.

A solution identical with the above was made very slightly alkaline; it contained 0·032 grm. of CaO. Kept at the boiling point, at the end of 15 hours the liquid had become very slightly yellow, the alkalinity had diminished one-half. In 36 hours the solution,

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These solutions were contained in flasks plunged into an oil-bath heated by steam, and by means of a Gay-Lussac condenser placed above the flask, the vapour from it was condensed and fell back into the solution, which was thus kept at the same density.

apparently neutral, contained 0·27 of uncrystallizable sugar, and 6 hours later it was freely acid and rich in glucose.

As the solutions were kept at boiling point in a flask only communicating with the atmosphere through a small tube, it was not possible for this trial to be influenced by the carbonic acid of the air.

The preceding experiments show that a very weak alkalinity is sufficient to preserve pure sugar from transformation into glucose by heat; on the other hand, if the sugar contains glucose, it is needful entirely to destroy it to prevent the transformation of the crystallizable sugar by heat.

EXPERIMENT IX.

To a solution containing 15 grammes of pure sugar and 4·48 grms. of uncrystallizable, 2 grammes of chalk were added, and it was kept at boiling point. At the end of 24 hours the liquid which had become brown, was neutral, and there had been no transformation of the crystallizable sugar, and traces only of the glucose had been destroyed.

The same experiment repeated with some neutral sulphite of lime, prepared according to Dr. Icery's directions, gave a similar result. There was no transformation of the crystallizable sugar, but the liquid had become coloured. Another experiment made with sulphite of lime kept slightly acid by excess of sulphurous acid, gave very different results. The liquid remained perfectly colourless, but at the end of 6 hours, 40 per cent. of sugar had been transformed into glucose.

The preceding experiments show clearly that it is the acidity and not the glucose itself which causes inversion.

EXPERIMENT X.

A solution of sugar containing in 100 cubic centimeters,

Crystallizable sugar....	15 grammes.
Uncrystallizable ,, ...	3·5 ,,
Lime (CaO)	1·27 ,,

was kept boiling, the condensed steam falling back into the flask.

A sample taken after 15 minutes boiling, cooled and filtered, contained in 100 c.c.—

Lime in combination,	0·68
Free Lime	0·56
Total „	1·24 grm.

After 30 minutes boiling—

Lime in combination,	0·624
Free Lime	0·560
Total „	1·184 grm.

After 45 minutes boiling—

Lime in combination,	0·624
Free Lime	0·560
Total „	1·184 grm.

The solution carbonated & filtered, contained—	Lime in combination,	0·620
	Free Lime	0·084
	Total „	0·704 grm.

Experiment XI.

A solution containing in	100 c.c.
Crystallizable Sugar....	15 grammes.
Uncrystallizable „	1·75 „
Lime (CaO)	1·27 „

was kept boiling during 20 minutes, and filtered; it then contained—

Lime in combination,	0·288
Free Lime	0·960
Total „	1·248 grm.

There was then added 5·5 per cent. of dry hydrate of lime, the solution treated with carbonic acid gas when hot, and afterwards filtered, contained—

Lime in combination,	0·288
Free Lime	0·032
Total ,, ...	0·320 grm.

The liquid had become very much decolorized.

Experiment XII.

A solution, containing—

Crystallizable Sugar,	15	grammes
Uncrystallizable ,,	3·5	,,
CaO	1·27	,,

was kept boiling for 20 minutes, then filtered. The filtered liquid, of a brown colour, contained—

A	Lime in combination,	0·720
	Free Lime	0·496
	Total ,, ...	1·216 grm.

The liquid A, carbonated, and filtered, contained—

A′	Lime in combination,	0·672
	Free Lime	0·000
	Total in combination,	0·672 grm.

The liquid A′, treated with 5 per cent. of lime, carbonated and filtered, contained—

A″	Lime in combination,	0·537
	Free Lime	0·000
	Total in combination,	0·537 grm.

The colours compared by Duboscq's colorimeter, taking for the standard the last—A″=1, were—

A″=1
A′=3·4
A =6·1

Experiment XIII.

A solution containing—

Crystallizable Sugar	15·	grammes.
Uncrystallizable ,,	3·5	
CaO	1·27	

After boiling one hour, 100 c.c. showed—

	Lime in combination	0·704
A	Free Lime	0·544
	Total ,,	1·248 grm.

100 c.c. of A carbonated and filtered, contained—

	Lime in combination	0·624
A′	Free Lime	0·048
	Total ,,	0·672 grm.

100 c.c. of A′ with 8 grammes of dry hydrate of lime added, carbonated and filtered, contained—

	Lime in combination	0·576
A″	Free Lime	0·032
	Total ,,	0·608 grm.

By the colorimeter A′ showed three times as much colour as A″ though the latter was strongly coloured of a deep yellow tint.

Experiment XIV.

100 c.c. of solution A in experiment XII was diluted with distilled water to a volume of 400 c.c. 100 c.c. of this diluted solution was treated with 10 grammes of dry hydrate of lime, carbonated and filtered. The colour after this treatment was still that of pale yellow juice. The 100 c.c. only contained $\frac{3\cdot5}{4}$ or 0·875 grm. of uncrystallizable, or rather of the calcic derivatives of this sugar.

Experiment XV.

100 c.c. of a solution of sugar containing 0·156 of glucose was treated with 5 grammes of hydrate of lime, carbonated and filtered. The solution was completely colourless.

100 c.c. of a solution of sugar containing 0·313 grm. of glucose treated in the same way gave a solution *nearly* colourless.

The estimate of colour is very uncertain, even with the aid of a colorimeter when we have no standard of comparison.* However, the preceding experiments sufficiently prove that without the use of at least 10 grammes of dry hydrate of lime per gramme of pre-existent glucose, it is impossible to obtain complete decoloration. This decoloration, besides, varies considerably even within very similar conditions.

In experiments X, XI, and XII, it was proposed to determine the quantity of salts of lime eliminated by the calco-carbonic treatment. The results were not satisfactory, and a number of similar experiments did not lead to any more favourable. The calco-carbonic treatment appeared to eliminate a very small fraction of the total quantity of salts of lime produced. These are probably the combinations with saccharic acid, for Dr. H. Reichardt has proved that sub-acetate of lead will also eliminate these combinations. These are they that colour the syrup; the glucates are not coloured. The salts of the apo-glucic acid are on the contrary very dark. The slight stability of the combinations produced will explain why we do not arrive at results perfectly accordant, with experiments of this nature.

One gramme of glucose would leave after the calcic destruction and the carbonatation, from 0·15 to 0·2 grm. of CaO in a state of soluble combination. The salts thus formed contribute to the production of molasses, and if we accept as a basis the saline co-efficient, the diminution of yield due to these salts might be approximately estimated. The 0·15 or 0·2 grm. of CaO transformed into carbonate by incineration, would give 0·26 to 0·35 grm. of ash, which at the co-efficient 5 will add at least 1·50 grm. to the molasses. The decoloration of glucosic syrups treated by lime might be partly effected by animal charcoal and partly by the calco-carbonic treatment which, according to the observations of M. Woestyn, has the advantage of perfectly clarifying the syrup.

We will now examine the loss of sugar which may result from the presence of glucose during all the course of treatment. The transformation of sugar, under the influence of glucose, increases with the temperature, and at the same temperature with the duration of its action. The following table, taken from Dr. Icery, will give a good idea of the action of glucose. We see that in juice No. 1, the purer of the two, 3 per cent. of crystallizable sugar was transformed into glucose during the concentration alone. The quantity of glucose was more than doubled.

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* I had not then by me Dr. Stammer's coloured glasses.

The figures are based on 100 parts of saccharine matter—

	No. 1.		No. 2.	
	Sugar.	Glucose.	Sugar.	Glucose.
Juice	98	2	87	13
Syrup	95	5	,,	,,
Syrup of 1st boiling	83	17	76	24
,, 2nd ,,	78	22	57	43
,, 3rd ,,	73	27		

A series of articles have been lately published in *The Sugar Cane* interesting to the manufacturers of cane sugar,* the following examples are from the December number (1871) p. 619.

In one case given, 17 per cent. of the sugar was transformed into glucose during the concentration of the juice in the battery. In another case the quantity of glucose produced was 12 per cent. The author of the article does not think he is far from the truth in admitting that in 100 parts of saccharine matter existing in the cane juice, there are generally 5 parts of glucose, and that this is increased to 15 per cent. during the concentration in the battery.

Apparatus for rapid concentration such as the *triple effet* and the Concretor, considerably diminish the transformation of sugar into glucose. The use of the vacuum pan has the same effect.

According to M. Fryer the concrete sugar obtained by means of the Concretor contains on the average 4·5 per cent. of glucose, and this is evidently the proportion of glucose existing in the raw juice. The proportion of glucose in the concrete sugar varies with the nature of the juice, as the concrete is only juice reduced to a solid state with its impurities.

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* "On the Manufacture of Sugar from the Sugar Cane and the Machinery Employed therein."

In experiments I. and III. the quantity of glucose was respectively 12·8 and 11 per cent. of the total saccharine matter. It is rarely that in actual manufacture the juice operated on is so rich in glucose. Notwithstanding this exaggerated proportion of glucose there was only a transformation of 2·5 and of 0·5 per cent. respectively, of sugar in 6 hours. In the *triple effet* the juice is exposed to a still lower temperature.

In the experiments II. and III. when the solutions were kept at boiling point, the transformation was much stronger, and in 6 hours half the crystallizable sugar had become inverted: the last experiments account for what takes place in the battery.

The proper use of sulphites ought to diminish the production of uncrystallizable sugar. We have not found the proportion in figures; but Dr. Icery affirms that he has come to this conclusion. We have seen by experiment IX. that to obtain a complete decoloration by sulphurous acid it is needful to operate on slightly acid liquor. Following the directions of Dr. Icery in these conditions, the transformation of sugar into glucose does take place, but we can understand that it is easy to regulate the acidity so as to reduce its injurious action to a minimum.

M. Dubrunfaut has cited in the *Journal des Fabricants* the results of the analyses of three samples of sugar, of which two were prepared according to Dr. Icery's method, and one by the ordinary process. It is to be regretted that the last was sugar from juice which had been concentrated in the common battery, whilst the two other samples had been manufactured by the most perfect apparatus. These two different methods of manufacture quite explain the differences in the analyses and tell neither against the Icery process nor in its favour.

In the ordinary working, with the evaporation over the naked fire, and the boiling in vacuum, it may be assumed without exaggeration, that one gramme of glucose existing in the juice will produce three more in the course of the working—thus 4 grammes of glucose are found in the residue which, according to the admitted hypothesis will prevent the crystallization of 4 grammes of sugar, thus the one gramme of glucose in the juice will have removed 7 grammes of crystallizable sugar from the product.

The new methods with all their improvements cannot completely suppress the formation of glucose and we must admit that at the least the original quantity of glucose present in the juice will be doubled, a gramme of glucose in it producing another gramme in the working, the two grammes will draw with them into the molasses other two grammes of crystallizable sugar, and the single fact of the presence of 1 per cent. of glucose will have diminished the yield of pure sugar by 3 per cent.

Thus in the best conditions the diminution of return due to the presence of glucose in the juice, is twice as great as it would be if the glucose had been destroyed at the commencement of the working.

The juice of the cane contains very variable quantities of glucose, generally from 0·2 to 1 per cent. of the weight of the juice. To apply the alkaline treatment with the calco-carbonic decoloration, it would then be needful to employ proportions of lime varying from 2 to 10 per cent. of the weight of the juice, which appears to be quite impossible in the colonies. The calco-carbonic treatment might it is true be partly replaced by a strong filtration through animal charcoal. It is difficult to judge at a distance, of the practicability of these methods whatever may be their theoretical superiority.

The simultaneous use of neutral sulphite slightly soluble, with animal charcoal might render very essential service. The presence of sulphite would prevent the development of fermentation and would neutralize, as it was produced, the acidity formed by the decomposition of glucose. The animal charcoal would greatly modify the coloration, which is the result of the neutralization.

The nearly complete absence of glucose from raw beet sugars renders the alkaline treatment very weak in the beet sugar refineries. Up till lately the refiners had not very freely adopted the alkaline treatment, although the calcic clarification had in many refineries replaced that by blood. The examples of M. Woestyn and of M. M. Boivin and Loiseau were needed before refiners gradually adopted the use of large quantities of lime and the calco-carbonic treatment, from which it is inseparable.

In the refineries of colonial sugar the alkaline treatment presents certain difficulties analogous to those which we have noticed in the juice of the cane. Cane sugars contain ordinarily from 2 to 4 per cent. of glucose, and sometimes as much as 6 per cent. The quantity of lime necessary for their decoloration would be very considerable. To a certain extent the difficulty may be avoided by the use of the centrifugal machine. The following example shows the amount of purification effected by the use of the centrifugal on some Havana sugar.*

HAVANA SUGAR.

	Before being Centrifugaled.	After being Centrifugaled.
Crystallizable sugar........	94·5	96·00
Uncrystallizable „	2·36	0·60

The centrifugaled sugar would be perfectly suitable for the calcic purification and the carbonic treatment. The use of large quantities of charcoal habitual in refineries allows of considerable reduction in the proportion of lime.

The syrup charged with glucose which issues from the centrifugal might be advantageously treated with neutral sulphite, which would continue in the glucose as long as it remained in the refinery. There would thus be the advantage of keeping a large proportion of the glucose for the distillery, without the fear of the transformation of a part of the crystallizable sugar. With this modification the alkaline working might perhaps be introduced into the refineries of colonial sugar.

Arlovetz, 30th March, 1872.

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* This experiment was made some time ago in the refinery of M. C. Say, at Paris, during my stay in this establishment.

ON SOME EXPERIMENTS WITH FEHLING'S COPPER SOLUTION.*

By T. L. Patterson, F.C.S.

The copper solutions used in the following experiments were prepared according to the instructions given by Fresenius. 34·632 grms. of sulphate of copper, dissolved in 200 c.c. of water, were added to a solution of 173 grms. of tartrate of soda and potash in 480 c.c. of soda solution of 1·14 sp. gr. or thereby, and the whole made up to 1 litre. They were tested with one of inverted sugar, prepared as follows:—0·5 grm. of pure dry loaf sugar free from glucose was dissolved in a small flask in 10 c.c. of water, 30 drops of HCl added, and a thermometer inserted. The flask, with its contents, was then placed in a water-bath for fifteen minutes, or until the thermometer indicated 70° C., when it was removed and diluted to 300 c.c. Each c.c. of this solution was thus equal to 0·001754 grm. of glucose.

The experiments were conducted in flasks, rather than basins or beakers; because, with the latter that portion above the liquid is liable to become over-heated to such an extent that, when the solution is stirred or shaken, part of it is likely to become reduced, and thus lead to erroneous results. Flasks are not liable to the same objection if they be occasionally shaken until they boil. When any portion is thus reduced the whole must be rejected.

Experiment 1.—(*a*). 10 c.c. of a copper solution were boiled with about 40 c.c. of water in a flask without precipitation. The standard sugar solution was then added from a burette graduated to ⅛th c.c. until, on filtering off a portion rapidly, no copper-coloured precipitate was obtained on the addition of a few drops of acetic acid, and one drop of a very dilute solution of ferrocyanide of potassium. 30 c.c. were thus consumed. Another experiment gave the same result, and $30 \times 0{\cdot}001754 = 0{\cdot}05262$ grm. of glucose, the amount required to reduce 10 c.c. of copper solution.

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* Read before the Chemical Section of the Glasgow Philosophical Society, March 11, 1872.

(*b*). 10 c.c. of the same solution were treated precisely as in (*a*), with the addition of 10 c.c of soda solution of sp. gr. 1·163. It now required 33 c.c. of the sugar solution for complete reduction, which is equal to 0·05788 grm. of glucose.

(*c*). Other 10 c.c. were boiled with the addition of 50 c.c. of soda solution. When 34 c.c. of sugar solution had been consumed, the cupric oxide was not all reduced; nor was reduction complete after the further addition of 14 c.c. in quantities of 2 c.c. at a time, testing after each addition. The result was the same when 50 c.c. were added to another portion of 10 c.c. in quantities of 5 c.c. after the 35th c.c.

The results of this experiment lead me to question the conclusions of Fehling, Fresenius, and others, who assume that 1 molecule of grape sugar reduces 10 molecules of cupric oxide. Had this been the case 10 c.c. of the solution in (*a*) would have consumed 28·5 c c. of the standard sugar solution, equal to 0·05 grm. of glucose, whereas 30 c.c.=0·05262 grm. were required. (*b*) and (*c*) I believe show the reason of this, and prove satisfactorily that the quantity of cupric oxide reduced, depends as well upon the alkalinity of the solution, as on the amount of oxide of copper which it contains. Consequently, as the amount of soda varies, the solution's power of oxidising grape sugar will also vary, and must be determined for each solution separately. When, moreover, the soda is in great excess, as in (*c*), accurate results cannot be obtained.

Experiment 2.—With the view of showing the effect of soda on an old solution, the following experiments were made:—

(*d*). A copper solution, 10 c.c. of which were equal to 0·05262 grm. grape sugar, had been in occasional use for about five months. For some time soda had to be added to prevent precipitation. 10 c.c. were found to equal 0·039 grm. of glucose; but, with the addition of 40 c.c. or so of soda, 10 c.c. were equal to 0·05614 grm. of glucose.

(*e*). Another solution, having the same sugar destroying power as (*d*), at the end of five months precipitated on boiling. 10 c.c. were equal to 0·04035 grm. of grape sugar. 10 c.c.+10 c.c. of soda solution of 1·13 sp. gr., and 30 c.c. or so of water, did not precipitate on boiling, and consumed sugar solution equal to 0·05331 grm. of glucose; and 10 c.c.+an addition of 50 c.c. of soda solution required 0·05702 grm. of inverted sugar for complete reduction.

We learn from this experiment that soda renews an old solution, as is well known; but the alkali must be added sparingly—in fact, not more than is necessary to prevent precipitation on boiling, otherwise it will have too high a glucose-destroying power, and so give a low per centage of fruit sugar, in any sample of sugar under examination. We see here also, as in Experiment 1, that the oxidising power of the cupric solution increases, as the quantity of alkali increases; so that by the addition of soda in excess, an old solution can be made to represent a greater amount of glucose, than the same solution did when new!

The deterioration of copper solutions kept for some time, such as those in Experiment 2, has been variously attributed to the action of light, absorption of carbonic acid, &c. In Watts's "Dictionary," we are told to preserve the solution in well-closed vessels to protect it from CO_2 and air. But, even when so protected and kept in the dark, a solution in constant use still deteriorates. To what, then, is this deterioration due? I have always found, on removing the stopper from a cupric solution bottle which has not been opened for a few days, that a partial vacuum existed within, and the vacuum was greater the longer the bottle remained closed. Clearly this vacuum was not due to the absorption of the small amount of CO_2 in the air of the bottle; it must, therefore, have been owing to the absorption of oxygen: and this I found to be the case, for, on inserting a lighted splinter into a bottle half filled with the solution, it was at once extinguished, nor could it be made to enter beyond the neck—a sufficient proof that the gas within the bottle was nitrogen.

EXPERIMENT 3.—To determine the amount of this absorption, whether it was partial or complete, the following experiment was made:—Into a tube closed at one end, containing 50 c.c., and graduated into ⅕th c.c., I enclosed a quantity of dry air over mercury, which after reduction to 0° C. and 760 m.m. pressure, measured 42·76 c.c.: 4 c.c. of copper solution—10 c.c. of which were equal to 0·05175 grm. of glucose—were then introduced, and the whole set aside in diffuse daylight. The experiment lasted about eight months. Absorption was slow and gradual, extending over a considerable period, but not so long as this experiment would lead one to believe. It was only allowed to stand so long, in order to be quite certain that absorption had ceased.

The copper solution in the tube had now a much lighter colour, and cupreous oxide was deposited on the sides for the space of about 1 c.c., where the mercury first came in contact with the solution. The reading of the tube, after making all necessary corrections, was 34·09 c.c. at 0°C., and 760 m.m. barometer. Now $42·76 - 34·09 = 8·67$ c.c. oxygen absorbed by the 4 c.c. of copper solution, and $\frac{8·67}{42·76} \times 100 = 20·28$ per cent of the original air. This agrees very well with the quantity of oxygen in the air, as determined by Bunsen, viz., 20·93 per cent., and shows that all the oxygen has been absorbed. The difference is due to experimental error. For instance, the barometer used was an aneroid, which always showed a slight variation when compared with a standard. The residual nitrogen was tested as before, but it would not support combustion.

The foregoing experiment shows satisfactorily the complete absorption of oxygen by the liquid; and in order to observe further the effect of oxidation and decomposition another experiment was made.

EXPERIMENT 4.—(*f*). The copper solution used in this experiment had a glucose-destroying power of 0·04965 grm. per 10 c.c. The CO_2 and Na_2O were estimated in separate portions of 10 c.c. each—the former in a CO_2 apparatus, and the latter by saturation with normal solution of H_2SO_4 boiling to expel CO_2, and backward titration with normal Na_2O solution. The Cu solution was thus found to contain 0·18 grm. of CO_2, and to have a neutralising power of 5·39 grms. Na_2O per 100 c.c.

Having been in almost daily use for a month, during which time it was kept in a cupboard, the solution was nearly finished. There was still no precipitation on boiling. 100 c.c. contained 0·30 grm. of CO_2, and had a neutralising power of 5·26 grms. Na_2O.

Two small bottles, (*g*) and (*h*), were half filled with solution (*f*), and securely stoppered. (*h*) was placed in the direct sun's rays, and (*g*) was rolled in paper and placed in a tin case, in order thoroughly to exclude light. After the lapse of eight months the bottles were opened and analysed.

(*g*). That bottle kept in the dark had not changed in depth of colour, no precipitate had formed, it remained perfectly clear on boiling, and contained 0·18 grm. of CO_2, with a neutralising power of 5·27 grms. of Na_2O per 100 c.c.

(*h*). The second bottle, exposed in the direct solar rays, was much lighter in colour, the stopper was with difficulty removed, and there was deposited at the bottom a copious crystalline precipitate of cupreous oxide. The solution filtered from this precipitate, gave a second precipitate on boiling, and 10 c.c. were equal to 0·00087 grm. of glucose. It contained 0·33 grm. of CO_2, and had a neutralising power of 4·89 grms. of Na_2O per 100 c.c.

The injurious effect of light on this solution is very well seen in (*h*). Nearly all the Cu has been precipitated; while the solutions (*f*) at the end of one month, and (*g*), are quite unaffectod by boiling. (*h*) has also increased 0·15 grm. of CO_2 and decreased 0·5 grm. of Na_2O in neutralising power, per 100 c.c. Now this gain in CO_2 could not have been the result of absorption from the atmosphere, for the CO^2 had not increased in the bottle kept in the dark (*g*), and the partial vacuum in the bottle showed that the stopper was perfectly tight. Nor could it have been produced by oxidation, as the bottle in which the solution was contained held about 100 c.c. and was half filled with the solution, the other half being air. 50 c.c. of air, weighing 0·0608 grm., and containing 0·014 grm. of O, are only equal to 0·01924 grm. of CO_2, whereas 0·075 grm., nearly four times that quantity, was found. Therefore the CO_2

found in this experiment is partially produced by oxidation, and partially the result of the decomposition of the tartaric acid promoted by the actinic rays.

The fixation of 0·50 grm. of Na_2O is conclusive on this point. The tartaric acid under the influence of light and absorbed O, becomes split up in such a manner that its neutralising power is considerably increased in the presence of the free alkali. We may suppose one molecule of the bibasic acid to decompose into one of another bibasic and one of a monobasic acid, besides CO_2, and so exert an extra neutralising power on the Na_2O to that extent. I made no experiments to determine what acids these are, but they are likely to be related to oxalic, and contain less carbon than tartaric acid.

At the end of one month (*f*) had gained 0·12 grm. of CO_2, and lost in alkalinity 0·13 grm. of Na_2O. This decomposition is similar to that of (*h*), but, for want of time and exposure to light, has not proceeded to the same extent. From the fact, however, of this bottle being in constant use—not under precise conditions, but kept principally in the dark, though occasionally in the light—now open, and again closed—I will not hazard an opinion on the results.

The CO_2 in (*g*), the bottle kept in the dark, was the same at the end as at the commencement of the experiment; but the alkalinity of the solution had decreased to the extent of 0·12 grm. of Na_2O per 100 c.c. So that, although when kept in the dark in well-stoppered bottles, the solution does not oxidise, yet it undergoes a slight internal decomposition, similar to that induced by light in (*h*), whereby the fixed acidity is increased in presence of the excess of alkali. Light is thus necessary for oxidation, and darkness retards decomposition; phenomena which I venture to assert are more general than at first sight might be supposed. With the exception of the decrease in alkali, the (*g*) solution may be said to be as good and sound as the original solution (*f*), proving that it can be preserved, under exceptional conditions, for a reasonable length of time (eight months in this case).

In Experiment 2, (*d*) and (*e*), I have shown the deteriorating influence of age on solutions in constant use. For the purpose of these experiments my solutions have been kept in the dark; but I have been in the habit of using bottles, for preserving the solution, made by the York Glass Company from a kind of dark green glass. These bottles cut off the actinic end of the spectrum as far as the green, and are useful for preserving HNO_3, silver, and other salts, decomposed by light. To test the preservative qualities of this glass for the Cu solution, I made another experiment, as follows:

Experiment 5.—One of the green bottles was half-filled with the solution and placed in the direct rays of the sun for six months. At the commencement of the experiment, 10 c.c. were equal to 0·05179 grm. of grape sugar; at the end, 10 c.c. were equal to 0.05000 grm., and the solution when boiled showed no sign of precipitation. The result is thus in favour of these bottles; for with this severe test the solution has only lost the power of oxidising 0.00179 grm. of glucose, while that kept in a white glass bottle under the same circumstances (*h*) had nearly all its Cu precipitated.

Did Fehling's solution only deteriorate by the absorption of O, there might be inserted in the bottle a perforated cork, through which a tube passed holding fragments of pumice moistened with a strong solution of pyrogallate of potash. I have not tried this arrangement but, as I have shown, in Experiment 4 (*g*) and (*h*), that decomposition takes place without the absorption of O, I do not think any useful purpose would be served by such an addition.

In conclusion, these experiments show:—

(1). That Fehling's solution has no definite grape sugar equivalent depending upon the weight of cupric oxide it contains, but that its glucose-destroying power varies directly (within certain limits) with the quantity of alkali present; and that when Na_2O is in great excess all the Cu cannot be precipitated with a solution of inverted sugar.—Experiment 1, (*a*) (*b*) (*c*).

(2). That old solutions are renewed by an addition of Na_2O, as our text books set forth; and, moreover, that by adding the alkali in considerable excess, the glucose-destroying power of the solution can be made to exceed that of the same solution when first prepared.—Experiment 2, (*d*) (*e*).

(3). That all the oxygen is absorbed by the solution from air in a confined space, as in a partially filled bottle.—Experiment 3.

(4). That under the influence of light decomposition is almost complete; and CO_2 increases to a greater extent than can be accounted for by the absorption of oxygen.—Experiment 4, (*h*).

5. That the amount of Na_2O in the solution decreases with its age, even when kept in total darkness; and that this loss of alkalinity is to be attributed to the decomposition of the organic acid into other fixed acids, the total acidity of which is greater than that of the original tartaric acid.—Experiment 4, (*f*) (*g*) (*h*).

(6). That a solution kept for eight months away from light in a bottle containing air is in good condition at the end of that time. Experiment 4, (*g*).

(7). That the solution is best kept for use in dark green bottles which exclude the actinic rays.—Experiment 5.

The President, after referring to the great scientific and practical interest of Mr. Patterson's paper, said that he had himself found the same results in his operations, although he had not prosecuted his inquiries as to the cause of those results to the same extent as the author of this paper. One thing he had observed was, the solution should be frequently renewed.

Mr. Sutherland referred to the action of carbonate of soda, and asked Mr. Patterson if he had tried it. He had found it useful in determining the amount of glucose in glycerine, and would like to know if there was any true glucose in ordinary sugar.

Mr. Patterson observed that he had not tried carbonate of soda in sugar testing, and that it was inverted sugar rather than true glucose that had to be determined. In reply to Mr. Tatlock he observed that it was probable that the red precipitate found in the operations was due to the decomposition of tartaric acid.—*Chemical News.*

ON THE MANUFACTURE AND REFINING OF SUGAR.

[*The Cantor Lectures, delivered before the Society of Arts.*]

By C. Haughton Gill.

(Continued from page 127.)

Lecture IV.

The juice, therefore, has now been defecated, carbonated, sent up stairs, heated to boiling, so as to decompose any remaining bicarbonate of lime in the solution, and to raise its temperature, so that the charcoal may have a greater action upon it, and it has then been allowed to run down through a column of animal charcoal 15 or 18 feet deep. The thin juice, as it is now called, issuing from the bottom of the charcoal, has become decolorized, somewhat freed from the lime, and from the gummy and albuminous bodies which the lime had failed to remove. The next process is to concentrate it, or to remove from this thin juice—and, as a rule, it is very thin—a great portion of the water which it contains. This is effected in the ordinary way by boiling.

In the older processes this was done by simply putting the juice into open pans, and putting a fire under them, in the same way as cane sugar is treated, but this method is no longer adopted. It is now done in an apparatus, which I may call a double effect apparatus, because the heat is used twice over, for the purpose of evaporating the liquid. The juice is put into a vessel somewhat resembling a locomotive boiler, being heated by steam, which passes into a number of pipes which run through the boiler, while a very partial vacuum is created above. When the steam is hot enough to make the liquid in the vessel boil rapidly it goes off in steam, but instead of sending it out into the air, and wasting the heat contained in this vapour from the boiling juice, it is made to pass by a tube into the tubes of the second vessel similar to the first, and though the temperature of the vapour thus obtained from the first pan is not high enough to make the liquid in the second vessel boil with any degree of rapidity at the ordinary atmospheric pressure, by connecting the top of No. 2 vessel with an air pump, and a condensing apparatus, so that the contents of the second vessel boil much below the usual temperature, this slight difficulty is entirely got over, and thus nearly the whole of the heat given off by the steam is utilised. If the steam coming from the original boiler were capable of evaporating, say, 10 lbs. of water out of the first vessel, theoretically, if there was no loss of heat, the vapour from the juice in that vessel should, on passing into the second vessel, be also capable of evaporating another 10 lbs. there, but practically it does not do anything like so much work; but still there is a considerable saving of fuel by employing two vessels connected in this way. In some factories three such evaporating vessels are connected together, but I believe the saving effected by using a third is very small, because the practical loss of heat is very considerable.

In this double effect apparatus the juice is brought to what is technically termed 25° Baumé, which I may explain thus. I will put into this jar some water, and I then put into it a little apparatus called Baumé's areometer, which, when immersed in water, sinks down until the top of the graduated scale is just on a level with the water in the jar. Now I will mix with the water some sugar, and we shall find that the liquid has become heavier, bulk for bulk, than the water, and in consequence the float will not have to sink so far into it in order to displace a quantity of the liquid equal to its own weight, but will float higher out, and higher in proportion as there is more sugar in the liquid. This is the kind of instrument which is constantly used in sugar factories to roughly determine the strength of the various solutions of sugar. When the juice is so far concentrated that this little float only sinks in it so far as the mark 25, it contains about 45 per cent. of its weight of total solids, including sugar, in solution. From this preliminary concentration, the juice, now technically "thick juice," goes to a cistern in which it is heated to boiling, and is then again filtered through fresh animal charcoal, to remove more of the colouring matters still present, and some of the albuminous bodies which are more readily absorbable from dense than from thin liquids. After this second charcoaling, the juice is almost colourless, and very brilliant and transparent, but is still not a pure or by any means a saturated solution of sugar, and, accordingly, before the maker can obtain any sugar from it in the solid form, he is obliged to reduce the quantity of water still further. This he does by the use of the vacuum pan, the name of which I have no doubt, suggests the nature of its construction. It is simply a pan, into which the liquid can be introduced and heated, while a comparatively perfect vacuum is formed above the surface, and in which, consequently, the liquid is capable of boiling at a very low temperature. [The lecturer then described, by means of a large diagram, the construction of the vacuum pan]. The liquid introduced into this vacuum pan of course loses water and shrinks, and from time to time more is added, until the pan is filled to a convenient height with the new and more concentrated liquor. At this point the admission of liquid is stopped for a short time, and the boiling is continued, until a sample, taken out by means of what is called a proof stick, is found to be of a certain degree of stickiness. At this time the liquid contained in the pan is a supersaturated solution of sugar—that is, a solution containing more sugar than the water present really ought to contain at that temperature. The problem which the man has to solve is, how to disturb that liquid in such a way as to bring about crystallization. I showed you, by some experiments at our first meeting, that all supersaturated liquids cannot be disturbed in the same way. A solution of sulphate of soda might be disturbed in such a way as to promote crystallization by merely shaking it, but one of hyposulphite of soda might be shaken vigorously without starting crystallization. The problem, therefore, is how to start crystallization in this supersaturated solution of sugar, at this comparatively high temperature, for, although it has boiled at a comparatively low temperature, it is still much hotter than an unaccustomed hand could bear. The right kind of disturbance in this case is, as a rule, to admit by little jerks small quantities of the liquor from which the boiled mass was made. The man, therefore, opens the cock, and lets in a small quantity of the thickened juice into the pan, and after a little time —the duration of which appears to me very uncertain, depending very much on the purity of the juice operated upon—the boiler, when he takes out the proof and examines it between his eye and the light, sees small grains of sugar beginning to appear. At this point he knows that crystallization has begun, and when it has once started it proceeds very rapidly, and in a few minutes after they have once made their appearance, the whole mass of liquid in that pan is filled with a mass of very minute crystals of sugar floating in a syrup, which is a normal saturated solution for the temperature at which the crystallization takes place. The excess of sugar forming the supersaturated solution is deposited, and we have now crystals floating in a solution only properly saturated for the temperature at which we have been operating. After the crystals have once formed, and we have this mass of crystals in the pan, little by little, more of the original solution is admitted, and so it is continually added and the water is evaporated until the pan becomes nearly full. The effect of doing it is this. As we admit a fresh portion of liquid into the pan, and evaporate off the water, the sugar crystallizes out at once; it no longer forms a super-saturated solution, for we have present a great number of crystals on which it can deposit. The crystals which are first formed now continue to grow by a continuous addition of sugar to their surfaces, and if this operation of adding to the solution of sugar and evaporating off the water be allowed to take place a sufficient number of times, and in a sufficiently gentle manner, the crystals will become a very considerable size. I have here some samples of sugar made by this process, some of which are very fine specimens. Here is some of very nearly the first quality of beet root sugar, which is made in France in the way I have described. It has been boiled for twelve hours in this way. After they once get "grain," as it is technically termed, in the pan, they add fresh liquor in very small quantities, and evaporate off the water, so that there is a slow deposit of sugar on the grains already formed, so slow that it deposits in a comparatively regular manner, and when that occurs we get large sized crystals. Here are some still finer, for which I am indebted to Mr. Duncan; indeed, it is the finest I have ever seen, though it is called raw beet sugar. It is made in England, from English-grown roots.

We understand now what has occurred in the vacuum pan. We have a mass of sugar crystals floating in a syrupy material, which consists of some water, a good deal of sugar, and all the impurities which the juice originally taken into the pan contained, because when crystallization takes place, the crystals formed consist of only one kind of matter; therefore, as a rule, the crystals formed in this case are practically pure sugar, and, therefore, what is left behind when the crystals are separated out must contain all the impurities originally present, plus so much of the sugar as has not been crystallized on account of the water still present. The mass in that state, when the boiling is finished, is let out by opening a plug or slide valve in the bottom of the apparatus. I cannot show you a mass actually so formed from beet root, because there is no beet root factory in England in which they work exactly in the way I have described, and where they make these crystals from beet root; and even if I could show you some of the mass as it comes from the pan, it would present a different appearance when exhibited to you from what it does when first drawn off, because it is then hot; and when it is cold, as it would be here, some of the sugar which the syrup contained when hot would be deposited, and would cement the crystals of sugar together, so that the mass would be somewhat hard. I have, however, prepared here what is not a bad representation of a mass as it comes from the pan, only I have rather too large a proportion of syrup. It is prepared by mixing some of the beet root sugar crystals in an impure syrup. It is a hard sticky mass, which does not look a very promising material from which to extract pure white sugar. The sugar now has to be recovered from this. The old method was to put the mass into moulds of some kind, at the bottom of which holes could be opened, so that the syrup could gradually drain away and leave the crystals above, but that is a very slow process, and the syrup which actually adheres to the crystals is much more sticky than that which I have here. It therefore drains away very slowly, takes a long time in operation, and is, after all, very imperfect. It is necessary, therefore, for the rapid success of the operation, that we should employ some force to aid the draining of the syrup, and the mode usually adopted is to make use of a so-called centrifugal machine. You know that when anything is set rotating very violently on its axis, the outer particles of it, at any portion of their course tend to continue their motion in the direction of a tangent to the circle at that point, and if you make the motion very rapid, the force which makes them tend to fly off becomes very considerable. I have here, owing to the kindness of Messrs. Wainwright, a model of a centrifugal machine, such as is actually employed. It consists of an outer casing of iron, inside which there is a drum strongly made, the sides of which consist of finely perforated copper, or in some cases of woven wire, but at any rate it has a pervious coating. Liquids are capable of passing through that coating, but solids are retained in the meshes. I will now pour in some of the mixture of syrup and beet crystals to the drum; and, while it remains at rest, very little, if any, will pass off. There is an opening in the outer casing, through which the liquid which passes into it may drain away conveniently. On setting the drum in motion you will find that the mass which was lying at the bottom becomes separated by the centrifugal motion and spreads itself up the sides of the drum, and as the motion is continued the liquor passes through the meshes, and the sugar is becoming quite white. The syrup is now running out very rapidly, and on increasing the speed of the drum, the sugar is spread evenly round the sides. When it is going at its highest speed I will dash on it a little water, which will be forced out through it and will slightly wash it, and thus help to carry away the last particle of syrup which might otherwise be left behind. On stopping the action, I can now scrape with my hand enough of the sugar to show you the nature of the operation that has taken place while the syrupy portion has drained away beneath.

In this way, and in this first operation, about three-fourths of all the sugar that can be obtained, is obtained if the process is conducted successfully. The syrup that has drained away is obviously worth keeping. It is a saturated solution of sugar, and for every pound of water we have there we have at least two pounds of sugar, for one pound of water will dissolve that quantity of sugar. It is obviously necessary to recover as great a quantity of that sugar as possible; the syrup is therefore treated in the following way:—The principle is very simple, although the details of the process are somewhat complicated. The solution is concentrated to a convenient point, and allowed to stand for a considerable time. It is concentrated in a vacuum pan, similar to that I have described; but it is found on the second concentration that you are no longer able to get grain formed in the pan. If the original solution or liquor is very impure, it is much more difficult to disturb that state of supersaturation than if it is a comparatively pure solution of sugar. Now this syrup that has been drained away is far more impure than the original thickened juice which we evaporated, and, accordingly, it is not possible to get crystals of sugar formed in the pan during this second concentration. But the liquid having been thickened to the degree which experience has found necessary, is run into large iron tanks, where it is allowed to stand for a fortnight or three weeks, and kept at a moderately high temperature. Crystallization then slowly takes place, and the mass is then stirred up with some fresh syrup, and put through the centrifugal machine again. This constitutes the second product of factories, of which I have two samples here. The result is, of course, less pure, both in appearance and in reality, then the first product, owing to the crystals retaining on their surfaces a large proportion of the still more sticky mother-liquid than the first did, and not only a larger proportion of that, but this mother-liquid itself is more impure; consequently the whole mass contains a much greater proportion of impurities than the first crop. The syrup from this second product is again concentrated, but by this time it is so impure that before crystallization can be brought about after it is concentrated, it has to be kept for six months in tanks at a comparatively high temperature. At the end of that time, a comparatively small quantity of sugar has deposited out. Some of such sugar I have here, but I am bound to say it is the worst I ever examined. It looks very nice, but if there are present any persons practically acquainted with sugar, they will be surprised to hear that it contains over 9 per cent. of salts, although it is an apparently bright, and what is technically termed "free" sugar. This leads me to mention very briefly the fact that, if in a concentrated solution of sugar you have various other matters, if you only give it time enough, it will crystallize out in actual chemical combination with some of these salts, and, consequently, this third product, which stands a long time, and which is formed from the mother-liquid containing a large proportion of impurities, is not merely sugar coated with impure syrup, but is actually an impure product, itself also coated with syrup, and is, consequently, often very much contaminated with salts.

The syrup which drains away from the third product has no longer any value to the sugar-maker, but is sold for the purpose of making spirits from. It is diluted, fermented, distilled, and thus is obtained a crude beet root spirit, which is afterwards rectified, duly flavoured, and sold as French brandy.

(To be continued.)

SUCRATES, AND THEIR APPLICATION TO THE EXTRACTION OF SUGAR FROM MOLASSES.

BY M. E. FELTZ.

[*Being a translation from the French of an Article written by request of the Council of the "Société Technique Russe," and read before a general Reunion of the Members of the Society, held at Goroditsch, on the 8th of Jan.,* 1872.]

(Concluded from page 199.)

The examples given in our last are abundantly sufficient to prove the strong purification which may be obtained by the means indicated. It is unnecessary to say that the batteries of boxes provided with parchment paper in a manner analogous to filter-presses (or osmogenes) have given the same results. Unfortunately the parchment paper is rapidly destroyed by contact with the strongly-limed sugar solutions which are used. It has therefore, been needful to endeavour to obviate this difficulty by replacing the parchment paper by some other material. As the mixture of lime and molasses may be rendered as dense as is necessary, we have found no difficulty in making use of coarse linen. Indeed, all kinds of dialytic medium may be dispensed with; the diffusion of the foreign matters is effected quite as well by the direct contact of water with the sucrate. In this case, and even when linen is used, the loss of sugar is greater than when parchment paper is employed. By keeping between suitable limits very favourable results may be obtained. By employing continuous apparatus the inventor (M. Stammer) has been able to realise a purification reaching a coefficient of purity of 80 of the residue, without losing more than 10 per cent. of the weight of the molasses in sugar. The purified sucrate may be used for melting, whilst the waters of exosmose will serve for manure.

The waters of exosmose of a quintal (about 1 cwt.) of molasses have amounted to 1,000 lbs., containing 3·44 per cent. of solid substances, as under:—

Sugar	1·02
Lime	·23
Ash	1·09
Organic Impurities	1·10
	3·44

The ash contains 77·6 per cent. of carbonate of potash. The residue purified, has given, after carbonatation, a syrup with a coefficient of 79 or 80. This syrup has yielded directly 17 per cent. of the weight of the molasses in raw sugar of a coefficient of 92, and 40 per cent. of syrup very nearly of the same quality as the original molasses. The remainder constitutes the absolute loss.

Repeated trials have proved that it is impossible to equal on the large scale the favourable results obtained by experiment, since the excessive cost for labour, the large space devoted to the plant, and especially the indefinite continuance of the process of purification are conditions which cannot be carried so far. It has been necessary to improve the apparatus, to profit by all the observations suggested by the working, to maintain a favourable temperature, &c. It has not the less been needful to add to the mode of operations which succeed in experiment, important modifications when working on a large scale, of which rapidity is an essential condition. In short, the purified product obtained on the large scale remains constantly, notably inferior in quality to what might reasonably be expected. In a word, we have been obliged to renounce provisionally the industrial application of this new method of dialysis.

The field then remains open for the improvement of the mode of operating, and it is to be wished that the efforts of new inventors in the process will arrive at more practical results. Those obtained at the manufactory of Anizy-le-Chateau are very interesting, without appearing superior to those obtained by Dr. Stammer. Not knowing whether M.M. Lair and Bilange have patented their method or not, I do not feel at liberty to publish the details which I hold by the kindness of these gentlemen through the mediation of M. Woestyn. On my part I have operated on a small scale. It is easy to obtain sucrate sufficiently pure for the syrup resulting from it to be boiled to grain, but such as it is, the process needs so much room and such a length of time, that it appears to me not adapted to industrial working.

The taking out of Pat. No. 88,304, by M.M. Boivin and Loiseau, will almost obviate the necessity of my speaking on the subject of their process of sucrate of hydrocarbonate, so far as it is applied to the extraction of sugar from molasses. It seems, in fact, scarcely probable that they have succeeded in obtaining this compound in a washable form, since they have patented its purification by the Stammer process. We must remember that the sucrate of hydrocarbonate of lime process is founded on the property possessed by limed sugar solutions, of giving by proper treatment with carbonic acid, a gelatinous mass, more or less consistent, containing the new compound of sugar, of lime, and of carbonic acid discovered by M.M. Boivin and Loiseau. If the process is real, it constitutes an important progress and forms a new opening to the researches of chemists. We can then only wait eagerly for the experimental demonstration which the inventors promise to make at La Villette. The precipitation of sugar from molasses under the form of sucrate of hydrocarbonate of lime is new, and belongs, without contradiction, to these gentlemen. M. Dubrunfaut has carefully noted its reaction, but he has completely misunderstood its nature.

To terminate this review of the proposed methods of extracting sugar by means of sucrates, we have yet to speak of a process founded on the action of alcohol on limed sugar solutions. We shall then have seen that all the properties of these solutions have been taken advantage of. We owe to Dr. Stammer a process founded on the precipitation by alcohol of divers sucrates of strontian and of lime. The inventor began by studying the action of alcohol on some solutions of strontian in thick molasses. Strontian does not, like baryta, possess the property of forming directly insoluble sucrates. Dr. Stammer observed that, in the presence of alcohol, sucrates were found varying in composition with the respective proportions of sugar, of strontian, and of alcohol present. With certain proportions he produced a precipitate perfectly granular and very easy to separate from the solution. In other conditions a caseous precipitate was formed. These different precipitates are, so far, sucrates of strontian of distinct composition. The sucrates of strontian do not reach the purity of the sucrates of baryta, although an undoubted purification takes place. Thus a molasses of the coefficient of 58·4 has been transformed into a syrup of a coefficient of 87 perfectly analogous to our filtered syrups, and ready to be boiled to grain. A strong pressure is sufficient to separate the sucrate from its mother-liquor. It is easy to obtain nearly 92 per cent. of the total sugar in the state of excellent syrup. These results are interesting, but the scarcity of strontian gives the greater interest to the experiments which have been made by the same chemist when substituting lime. These experiments have led to some results quite comparable to those obtained with strontian, inasmuch as the respective proportions of lime, of sugar, and of alcohol, are the same as those found with strontian. The inventor not being able to obtain a patent in Prussia, has not published the proportions which have given the best results. I will only report one trial made on a large scale, on 70 lbs. of molasses containing 36·4 lbs. of sugar. Its apparent coefficient of purity was 61·7. Treated by the best proportions of lime and alcohol, this molasses furnished a sucrate (A) separated by hydraulic pressure from its mother-liquor (*a*). A portion of sucrate (A) was submitted to another washing in alcohol and gave a washed sucrate (B), and some washing water (*b*) the following are the analyses, into the details of which it is impossible to enter here:—

Of solution (*a*)	5·77	lbs. of sugar, coefficient	27·2
,, (*b*)	2·25	,, ,,	35·0
Total	8·02	,, average coefficient	28·9
Of sucrate A	15·4	lbs. of sugar, coefficient	81·0
,, B	10·2	,, ,,	86·8
Total	25·6 lbs.	,, average coefficient	83·3

Thus, on the 36·4 lbs of sugar contained in the original molasses, there was

Lost in solution	8·4
Obtained in sucrate	25·6
Missing	2·4

Or, of 100 parts of sugar contained in the molasses, there were:—

Lost in solution	23·1	
Obtained in sucrate	70·4	of a coefficient 83·3
Missing	6·5	
	100·0	

The product at a coefficient of 83·3 is sufficiently pure to be used in melting and thus constitutes a great economy of lime. The inventor has not obtained a patent in Prussia for the application of this sucrate to defecation.

The precipitation and extraction of sugar from molasses by the simultaneous use of lime and alcohol appears to be attained by the process which we have just recounted. But the use of alcohol presents some grave inconveniences which do not permit us to hope that it will rapidly become general. Besides, if we wish to use alcohol for the extraction of sugar, it appears preferable to set up M. Margueritte's process, invented before those of either Stammer or Scheibler, and solving the question very simply.

The Margueritte process is based on the insolubility of sugar in concentrated alcohol, and its solubility in weaker alcohol just sufficiently concentrated to precipitate the impurities contained in the sugar. The process is as follows:—

To one kilogramme (2·2 lbs.) of molasses at 47° (Baumé) there is added (cold) one litre (1·76 pts.) of alcohol at 85°, to which 5 per cent. of sulphuric acid at 66° Baumé has been previously added. After filtration to separate the precipitated impurities, another litre of alcohol at 95° or 100° is added, also 500 grammes (1·1 lb.) of crystallized sugar; the crystallization of the sugar from the molasses then takes place rapidly, and 850 grammes (about 1·9 lb.) are obtained, of which 350 grms. are extracted from the molasses. This process thus produces 35 per cent. of the weight of the molasses, in sugar, or extracts 70 per cent. of the contained sugar. The following is an analysis of sugar thus obtained:—

Crystallizable sugar	99·50
Uncrystallizable sugar	0·50
Ash	traces.

It is needless to observe that this process requires much larger quantities of alcohol than the methods of Stammer and Scheibler. However, with a well-arranged plant the Margueritte process appears to be preferable to the simultaneous use of lime and alcohol. M. Woestyn informs me that the company of Fives-Lille have erected a complete apparatus for this process, which is expected to be at work the ensuing summer. I will study the process there and report to the society the result of my observations. The same company will also erect and work an apparatus for the osmosing of sucrates of lime in order to obtain comparative results.

It would be imprudent to conclude these observations with any definite judgment respecting the solution of the problem of the extraction of sugar from molasses. My aim has been simply to show with what difficulties this result is beset, and to give some idea of the numerous and persevering efforts made towards its solution during thirty years. These efforts have not been unfruitful. Already some doubtful points have been cleared up, and some false ideas having been exploded, the truth may perhaps be reached at some future time.

THE SUGAR QUESTION.

During the past month the British refiners have been extending their field of action both within the country and abroad. It is a very important point that all other branches of the sugar trade should understand that their interests and the interests of consumers are identical with those of British refiners, as is undoubtedly the case. For when once the truth comes to be acknowledged that the sugar question is an international one, no Government, even if the reverse of "paternal," can afford to ignore it, and it will be seen that whatever is likely to place British refiners perfectly on a level with those of other countries is sure to be best for the British nation, and as such, one of the legitimate objects of international legislation.

The West India Committee who represent the importers of sugar, &c., from those colonies, have met the refiners, and have since memoralized the Lords of the Treasury for the revision of the Convention.

In places where the question has been properly put before them, the wholesale grocers have seen at once their interests to be the same as those of the refiners, whose action they have supported by memorials to the Lords of the Treasury, or petitions to Parliament. Important support has been received from quarters whence it could scarcely have been expected, and the general public has been appealed to through the columns of *The Times*—the following letter was *apropos* of Mr. Lowe having given way on the question of the coffee duties so far as to defer the reduction for a month in justice to the trade who held large stocks.

To the Editor of the "Times."

Sir,—Mr. Lowe has eaten his own words, and you may go on drinking your coffee without any flavour of injustice in the cup. You are a man of good taste, sir, and, doubtless sweeten yours with (Paris) loaf sugar.

We say Paris loaf sugar, for English loaf sugar is almost a thing of the past, and English moist sugar must soon follow in the bitter wake of its sweet brother. You will suggest as a reason for this that the Paris sugar refiner may be cleverer than the English and cannier than the Scotch refiner, and can make better sugar cheaper. This may be the reason, but every sugar refiner in London, Greenock, Liverpool, Bristol, Manchester, and Plymouth will tell you he believes the reason to be that the Sugar Convention of 1864, which binds Great Britain, France, Belgium and Holland, has, owing to vital changes in the production of sugar, and in the duties imposed by these several countries and for other reasons, ceased to work fairly, and now works most favourably for France and most unfavourably for Great Britain. You will say, sir, is there no clause in the Convention enabling it to be modified in such an event as this? There is. You will exclaim, why, when an industry so important, employing in Great Britain some 30,000 hands and connected so intimately with the prosperity of our colonies—why, when such a great industry is jeopardized, do you not lay your grievance before the Governments who were parties to the Convention, and appeal to their sense of justice for leave to re-open the Convention? We have done so, and, with one exception, they consent. This one exception is our own.

A memorial has stated the case, as we think, clearly to the Lords of the Treasury, and their answer is a curt, though courteous, "No!"

But ours is (says Mr. Lowe) not a paternal government. Is it, then, a despotic one, or is it only that its members are disciples of Gallio?

Your obedient servant,

April 5. A Sugar Refiner.

The writer might, we think, have drawn some encouragement from Mr. Lowe's tardy assent to this act of justice to the coffee trade, as showing that he is not unamenable to reason and pressure. The next letter is one of considerable importance, and we give it in full, though our readers may be already acquainted with some of the facts it details so clearly.

To the Editor of the "Times."

Sir,—As I see a letter on this subject in your columns of April 6th, will you allow me very briefly to explain the state of the case? It is necessary first to point out, for the assistance of those who are likely to confuse the two subjects, that this Convention has no relation whatever with the French Commercial Treaty, and that arguments against the latter would not only be inapplicable to this Convention, but would rather tell in its favour, since while the Cobden Treaty aims at propagating free trade principles, and removing the protectionist idea of raising revenue at the expense of the foreign producer, the Sugar Convention is a modest and practical mode of removing an interference with the natural course of trade which can be removed by no other means, not by a reduction, but by an increase in the revenue of each country through the abolition of bounties paid by them either unwillingly or unconsciously. While the Treaty is repudiated by France in order to increase her revenue, the Sugar Convention will be rigorously adhered to by her for the same purpose; and as we have, with such a good grace, assented to her withdrawal from the one, we may the more easily ask her to join with us in a revision of the other, so as to insure a return to the natural course of trade, and an addition of some 20,000,000f. a year to her revenue.

The exportation of refined sugar has always been a cause of difficulty, because the duty is paid on the raw sugar, which produces different quantities of refined according to its quality. It is impossible, therefore, to say exactly what amount of duty has been paid on refined sugar which is presented for exportation, and on which drawback has to be paid by the Customs, and, therefore, there is a risk either of paying two much drawback, and thus causing a loss to the revenue, and giving a bounty to the refiner; or of paying too little, and thus causing a loss to the refiner, and prohibiting exportation.

In 1864 an arrangement was entered into between England, France, Belgium, and Holland, with a view to finding a remedy for this state of things, the Governments of those countries being naturally anxious to avoid a loss to their revenues. The remedy adopted was only a partial one, and a memorial which has just been addressed to the Lords of the Treasury by the refiners of Great Britain and Ireland explains that the remedy has become still less effectual since the great increase in the duties in France.

The new remedy proposed is that in all the countries duty shall be paid only on sugar as it goes into consumption. The whole difficulty of drawbacks would then disappear, since the refined sugar exported would have paid no duty, and therefore would claim no drawback. This proposal meets with very general approval among large sections of the sugar trade abroad, and the governments of the foreign countries have signified to deputations which have waited upon them their readiness to consider the matter by meeting in conference for the revision of the Convention. The only difficulty is with our own Government, which declines to re-open the question, in spite of a clause in the Treaty which provides for such a necessity.

Though we have received no official reasons for this decision, we are given to understand that, though we have made out our case, the Government is of opinion that all international trade arrangements are bad, that in commercial matters the consumer alone is entitled to the consideration of the Government, and finally, that trade should take care of itself.

As far as the Convention goes, we are prepared to combat these views. If they be true, the Government of 1864, in which Mr. Gladstone was Chancellor of the Exchequer, made a great mistake, and all the care and trouble which were taken in establishing the Convention was so much time and money thrown away, and the doctrines, with the reasoning on which they were based, which we find in the official documents and reports of the Conferences, were fallacious. We base our claim to consideration on the fact that the Convention, good or bad, exists, and that, if we have succeeded in showing that it does not now answer its purpose, the clause which provides for the introduction of modifications should be put in force. But we are prepared to show further that the purpose of the Convention is good, necessary, and based on sound principles of free trade. One of those principles is, that the natural course of trade shall not be interfered with, but the giving of bounties on exportation is an interference with trade, and, in the present instance, it causes sugar to be refined for the supply of this country, where coal is cheap, and the raw material is procured from all parts of the world, in a foreign country where coals are dear, and raw sugar is procured from only one source ; and it will eventually cause raw sugar, which would naturally come here, to go to another country, where English ships have to pay a surtax.

Next we are told that the consumer alone is to be considered. In this case, then, he must be considered, in spite of the interference with the natural course of trade, and whatever benefits he gets must arise from that interference. In other words, in the country where the trade is destroyed the consumer is to be benefited. This is evidently a false doctrine, since its universal application would involve the proposition that a country which had no trade left would still have consumers, and that those consumers would be highly favoured. It would also involve the proposition that a reduction of competition among producers causes a reduction in the price of the article produced.

Finally, we are told that trade ought to take care of itself. This we quite agree to, and in the present instance we wish to take care of ourselves by pointing out to foreign Governments that they are paying excessive drawbacks and sustaining loss to their revenues; but we know that representations to foreign Governments are always made through official channels, and, ready as we are to take care of ourselves, we cannot in the endeavour to do so break through the rules of International etiquette, and address ourselves to foreign Powers without the assistance of our Government as the natural and recognized go-between.

If, throughout Europe all sugar duties were as we now propose, levied only on the sugar when ready for consumption, no further possibility of interference with the natural course of trade would exist; each Government would be free to make what changes it pleased in its rate or scale of duty, and the much-vexed sugar duty question would be set at rest for ever.

All we ask is, that a Conference should be held to revise a Convention which is now in force, which does not now answer its purpose, and which provides in its terms for such a revision under such circumstances, and the effect of what we ask for will be, not to reduce, but to increase the revenues of all the countries interested.

I am, &c.,

A. W. Gadesden,

Chairman of the Committee of Sugar Refiners of Great Britain and Ireland.

A Conference on the sugar question was held at Brussels, on the 17th, 18th, and 19th of April, at which British, Belgian, and Dutch refiners, and the French, Belgian, and Dutch raw sugar manufacturers were represented by nearly fifty delegates. The French refiners generally had sent no delegate, but one French refiner, M. Clerc, attended and took part in the proceedings.

The Committee appointed by the delegates, and who alone voted on the resolutions after they had been fully discussed, was composed of the following gentlemen, each of whom represented either the refining or manufacturing interest of one of the four countries parties to the Convention of 1864:—

Baron la Fontaine, President of the Conference, delegate of the Belgian sugar manufacturers; M. Georges, representative of the French sugar manufacturers; and M. Clerc, the only French refiner present; Mr. Robert Blair, delegate from the British refiners, and Mr. James Duncan, as an English sugar manufacturer; M. Reesse, delegate of the Dutch refiners, and M. de Bruyn of the Dutch manufacturers; Mr. Gevers, the delegate of the Belgian refiners; and M. Jules Cartuyvels, Secretary.

A reporter was present at the Conference, and took down the details in full, but as we have not yet received a copy we can only give little more than the questions discussed and the resolutions passed. For a short extract from the opening speech of the President, Baron la Fontaine, we are indebted to the *Journal des Fabricants de Sucre.*

"The inauguration of this Congress is an event of great importance in the annals of the sugar industry. Your discussions open to you a new prospect, and present the spectacle of an industry which, essentially universal from its agricultural ties, ignores frontiers and thus proves that it has no nationality.

"Inspired by these thoughts let us examine the difficulties of the situation with calmness, and with a sincere spirit of conciliation; we shall find, gentlemen, a solution satisfying at once the interests of the cause, and giving, if your views are moderate, to the various branches of the great sugar industry, that stability which is indispensable to its prosperity.

"These advantages arising from your deliberations will give to Belgium the honour of having seen opened at Brussels our first International Congress. I owe to this circumstance the high and difficult mission of presiding over your assembly; let me hope, gentlemen, that giving me credit for those sentiments which animate me, your kindness will aid me in the accomplishment of my task."

The proceedings were conducted throughout in French.

The resolutions were considered in the form of questions, and answered affirmatively or negatively by the Committee after being discussed by the delegates generally. The questions put and answers given were tantamount to the passing of the following resolutions, which, as embodying the opinions on the sugar question, of those best qualified to judge in the four countries parties to the Convention, are of great importance.

I. That the Convention of 1864 devoted to the principle of equality between the four contracting powers has not attained its object.

II. That there is therefore cause for its immediate modification.

III. That the four Governments parties to the Convention of 1864 be desired, with as little delay as possible, to call a meeting of the International Convention to devise some system which shall suppress all drawbacks, and which whilst leaving the fullest freedom of working to the internal manufacturer, and perfect equality in competition to the several national industries concerned, shall secure to the Treasury in each country the full amount of duty. With this aim in view the Congress recommends the study of the system of working in bond.

IV. The Congress recommends that the four contracting countries should meanwhile take immediate steps for the periodical revision of the types and the maintenance of their identity, and it desires the cessation of those abuses which have been pointed out in this assembly.

V. The Congress desires that the needful steps may be taken to induce Germany and Austro-Hungary to enter into the Convention.

VI. That another Congress of the sugar interests shall be held next year.

The IV. resolution was opposed by the British delegates, who thought it would only be necessary in case the International Convention did not meet, or its meeting were delayed, or in case the other resolutions of the Conference were not carried out by the Convention.

The best results are, we think, to be hoped from this Conference and its proceedings.

The letter which follows contains an extract from a speech of Mr. Gladstone in 1866, which strongly supports the action now asked of Her Majesty's present Government by British refiners.

To the Editor of the "Times."

Sir,—You have recently published some letters on the International Sugar Convention. Please give me, as representing the Scottish sugar refining trade, a small space in your paper to protest against the indifference of the British Government to the representations of the trade.

The British Government are parties to an International Convention or Treaty regarding sugar, the object of which is to ensure a state of things whereby the sugar interests of all the contracting countries shall be placed on a footing of absolute equality. That treaty came into force on the 1st of

August, 1865, and will continue for 10 years from that date. It contains a stipulation that the contracting powers may make any modification in it not inconsistent with its spirit or its principles, and the utility of which may be shown by experience.

We represent to our Government that such a modification is now called for, experience showing it to be not only useful but even necessary, and that we are suffering from an uncontemplated working of the Treaty totally at variance with its principles and spirit.

We are prepared to propose a modification which shall adapt itself thoroughly to the altered circumstances, and, indeed, carry out the spirit of the Treaty more exactly than its original machinery could ever, from its very nature, be capable of doing. We ask the Government to submit to a proper and competent tribunal, which is a Conferenc of the representatives of the Powers who concluded the Treaty, our view of the state of affairs, and our proposed remedy. We do not ask the Government to commit itself beforehand to the adoption of the proposed remedy, nor even to the admission that the disadvantage we complain of exists. If the Conference is not convinced of the existence of the grievance and the propriety of the remedy, after it has had an opportunity of fully discussing the question, not from our point of view only, but from that of all the other parties interested in the subject, then the Government may leave the matter as it stands.

We only ask the Government to invite a Conference in the proper diplomatic form, and we still hope that the dislike of the Chancellor of the Exchequer to all trade treaties may give way on the present occasion, where its being given as a reason for refusing our request is totally irrelevant. If we were asking the Government to enter into some new Treaty, it might be fair to argue the question whether all Trade Treaties are bad or not. But we are not asking for any new Treaty; we only ask for the carrying out of the existing Convention in accordance with its spirit and principles, and the putting in force of one of its provisions which contemplates the possibility of such action as we propose.

It will be time enough to discuss the renewal of the Treaty when it is about to expire. When that time comes we will be prepared to meet Mr. Lowe's antipathy to all Trade Treaties with the opinions of many authorities as weighty as himself. One such authority I would ask you to re-print, as it refers specially to the Treaty in question. I take it from your paper of the 16th June, 1866. Mr. Gladstone therein says:—

"About that time (1864) a communication came from the French Government to that of England representing that, without interfering at all with the liberty of each State to levy from sugar for fiscal purposes whatever amount of tax it might think fit, it was very desirable to remove every artificial inducement by which sugar was led to one country rather than another, and that it would be also most desirable to combine with the system regulating imports a reconsideration of the bounties upon exports, so that with regard to imports from countries where refining has taken place, there would be a perfect freedom of trade in the absence of these peculiar inducements. Her Majesty's Government could not but perceive that that would be a beneficial arrangement, beneficial alike to the importers, the refiners, and the consumers. They therefore entered very freely and cheerfully into the views of the French Government. A Conference was accordingly assembled, comprising representatives of England, France, Belgium, and Holland, and after investigating the whole subject they came to the conclusion that certain things ought to be done at once with respect to a modification either of duty or drawback. The provisional arrangements thus suggested were all of a character tending to equal trade. Her Majesty's Government, therefore, cheerfully concurred in them, and proposed to Parliament measures which were necessary to give effect to the views of those international representatives at that stage. . . . There could be no doubt, he apprehended, that Her Majesty's Government were right in entering into this joint conference, becanse to destroy the barriers which now interposed between different countries in this way was a matter of great importance."

Such being the sentiments of the right hon. gentleman now at the head of the Government, I am emboldened to hope that our small request will yet be granted.

I am, Sir, your obedient servant,
JOHN NEILL, Jun.

Greenock, April 25.

Our notice of the proceedings which have been taken on the sugar question cannot be better concluded than by mention of the fact that a note has been received by the Chairman of the Committee of Sugar Refiners, to the effect that Mr. Gladstone was in communication with his colleagues, and with the Customs department, on the important question which the sugar refiners of Great Britain have brought before the Treasury, and respecting which they will shortly receive further communication from the Customs department.

MANURING SUGAR CANE.

At a late meeting of the Gadsden (Fla.) County Agricultural Association, one of the members, Mr. Jesse Wood, read the following report of an experiment with the sugar cane, on one acre. The experiment was not made particularly to try how much cane could be raised on an acre, but rather to ascertain the effects of special manuring upon old and poor upland soil. Mr. Wood says:—

I selected an acre of poor pine land, which had been in cultivation about ten or twelve years. Manured one-half with good, but not thoroughly rotted staple manure, the other half with compost, made of lot manure and cotton seed. Planted in rows four and a half feet apart. After breaking the ground deeply, cultivated as shallow as possible. The last ploughing, manured with about two hundred pounds of dissolved bones and Peruvian guano, by running a small scooter furrow in the centre of the rows—running around the cane with a large sweep, which covered up the fertilizer, leaving the ground nearly level. I decided not to use the same fertilizer in like manner on cane again, as I could see no improvement in the growth of the cane. But after ascertaining the extraordinary sweetness of the juice, I determined on repeating the experiment another year, as I could not account for the almost incredible amount of saccharine matter in any other way than by the benefit of the fertilizer, which was taken up in the maturity of the cane, in place of increased growth. Four gallons of this juice made one gallon of syrup. Another patch of cane grown near by, on similar soil, except that it was new land and heavily cowpenned, required seven gallons of juice to produce one gallon of syrup. The yield of the acre was thirteen barrels of syrup of a very superior quality, a portion of which was boiled down to sugar, which was also an excellent article.—*New Orleans Home Journal.*

NATAL.

On the whole, the weather has been generally favourable, the growing season for cane having continued throughout the winter, and the dry weather set in at the usual time of wet, which made the spring late, but it suited well for sugar making, which was thrown back through the late rains.

At the end of the year several of the sugar estates had one-third of their crop to make, through the scarcity of the labour supply, and on some of them a portion of the crop which ought to figure in this season's returns will have to stand over till next season. This is a serious evil and a great loss—first in the loss of the money, and second in the loss of the ratoon crop; and while such a state of things continues, it is impossible for the colony to make that amount of headway which, under more favourable circumstances, it ought to do, and the benefit which ought to have resulted from the exceptionably favourable seasons of this and last year has been partially lost in consequence. With a continuous reliable labour supply, accompanied by such fine seasons as the last two, sugar-planters would soon be in a position to choose their own bankers and dictate terms to their agents, which in many instances, unfortunately, they have not hitherto been in a position to do; the ills and drawbacks of the early days of sugar-planting would be forgotten, and their improved state of affairs would enable them to resist the ill-effects of less favourable circumstances which, sooner or later, are sure to follow in time to come as they have done in the past—such as frost, fire, and flood.

The breadth of land under sugar has increased during the year over a thousand acres, and although a considerable portion of sugar is yet to make, there has been an increase of over 150 tons. The average yield of sugar per acre this season is 2 tons 3 cwt. 1 qr. and 9 lbs, as compared with 1 ton 19 cwt. 0 qr. and 22 lbs. for 1870. There is also a considerable increase in the quantities gathered of coffee and cotton. The acreage, however, under these crops, comparatively speaking, is small. Altogether, the balance is considerably to the credit side of the account of the district, and planters were never in more hopeful circumstances at any period than they are now, since planting was commenced in Alexandra.

Yield of Sugar.

Our Alexandra correspondent's interesting statistical communication reveals the startling fact that the average yield of sugar in that district this season has been 2 tons, 3 cwt., and 37 lbs., or 4337 lbs. in all, per acre as compared with 1 ton, 19 cwt., 23 lbs., or 3923 lbs. in all, during the season preceding. There is no reason to mistrust the accuracy of this statement. It is the result of returns carefully collected and critically examined. As the average for a whole district we venture to think that no country can show a larger result. The fact bears testimony to the excellence of soil in Alexandra and the suitability of the climate for cane culture and sugar manufacture. It leads one to regret that a region capable of such production should remain so sparsely occupied. There are tens of thousands of acres of the richest land in Natal lying untenanted between the Isipingo and the Umtwalumi; and it is disgusting to think that year after year slips by without any additions from outside to the industrial population. Railways and the enterprise which railways bring in their wake would change all this, and attract attention to a district which ought to be the most productive and most thickly populated portion of Natal.—*Natal Mercury.*

BARBADOES.

There has been a change in the weather in the last day or two, with light showers and a strong breeze, and cloudy. The reaping of the crop has become general, the canes yielding in the black soils not more than a hhd. to the acre. Even where they appear fine and of good growth they are not juicy. Yet they make good sugar. The *Argyra*, for London, left on the 21st; and the *Sylph* is loaded and ready for sea. Besides these there have been shipments to New York and Boston of molasses as well as sugar, at from 4 dols. to 4·50 dols for sugar, and 20cts. per gallon for molasses exclusive of puncheon. Quite a number of vessels have dropped in during the last fortnight from the United Kingdom, as well as the United States and the British Provinces, and the wharf is covered with goods of every description for the warehouses or for export. The market is well supplied with breadstuffs and provisions, horses and mules from the States, fish from Newfoundland, and lumber from the Provinces. A large export trade has of late years grown up in lime, for Demerara, where it is applied to the fields as manure, as we use guano. The shipment last year reached 11,000 hhds., making the chief article of freight on board the schooners engaged in the trade between the two colonies, which take also a large number of emigrant labourers with their goods, and bring back wallaba shingles and plantains.—*West Indian.*

THE BEET ROOT IN FRANCE AND GERMANY.

The temperature has become modified during this last week in such a manner as to be favourable to the beet root, which had begun to need a little more humidity. It has rained and still rains intermittently, but these seeds cannot be hurt by real March showers, if they are not so prolonged as to interrupt the culture. A little more heat is required, but we are in the period of the red moon so feared by our cultivators; and who this year appear to wish to experience all these disagreeable effects, when they are not injurious. Up to the present the sowing has proceeded very actively, and the young beets spring in favourable conditions.—*April 20th.*

In Germany, according to M. Licht's report, the state of the weather appears to have been very nearly the same as in France, and they have had, as well as we, alternations of rain, sun, and wind. The culture was not interrupted, but in consequence of the frost the vegetation has not made much progress, and the leaf of the beet has not yet been seen, although in the neighbourhood of Magdeburg it has now been sown at least three weeks.

The late frosts have had a certain influence on the corn, of which some fields will without doubt have to be devoted to the beet root.

M. Licht estimates the excess of beet sown over last year at from 5 to 10 per cent.

Correspondence.

THE ELEPHANT CANE IN GAUDELOUPE.

To the Editor of "The Sugar Cane."

Sir,

The great importance of securing the best variety of canes has induced planters to regard with interest the introduction of any new variety. A few years ago a plant which differed in some respects from the Tahiti cane (among other differences in the fact that the edges of its leaves were free from serrations) became the subject of much interest in the French Antilles. This cane was considered identical with the Salangore cane of the East. A number of plants were imported into Antigua and cultivated by the proprietors of the Belvidere group of estates. The result of the introduction of this cane was not satisfactory, and the further trial in Gaudeloupe has led to its being generally discarded. Among the cane fields in this island a few acres of the "Salangore Cane" are not unfrequently met with. Their appearance differs from that of the Tahiti cane, from the joints being shorter and the colour more pale or faded; the difference in the leaves is perceived as soon as their edges are touched. So far from presenting the appearance of a more vigorous growth than that of other cane patches, they are somewhat more weakly and dwarfed; and it seems almost certain that the cultivation of this cane will be abandoned. Planters say: 1st. That the cane requires eighteen months or longer to ripen. 2nd. That the juice is less rich, and its proportion to the woody fibre is less. 3rd. That it suffers more severely from drought than the ordinary variety.

Some time ago a notice of the "Elephant Cane" appeared in your columns. Considerable pains and no little money have been bestowed by Mr. Lauriol of this island, upon the introduction of this very promising variety of cane into the West Indies. We were shown a plant of the Elephant Cane by the Count d'Adhemar, the director of the factory now being erected by the "*Compagnie des Usines Sucrières à Concretors.*" This plant was on the estate of M. Cherot de Frontville, who has contracted to sell canes to the company. The plant was vigorous and the stems of a dark purple without streaks, and were very much thicker than those of neighbouring plants. The cane, at its thickest part, measured two inches and three-eighths in diameter. M. Lauriol also showed to us, near his residence at Trois Rivières, a promising young plantation of the Elephant Cane ratoons. They were long in the cane, very vigorous and healthy, and the number of canes to each root was a fair average. There was but little difference in the thickness of the canes; one that we measured was two inches and three eighths in diameter. They well deserve the name of "Elephant." The following is an extract from a letter from M. Lauriol:—

"I beg your acceptance of a few plants of the "Elephant Cane" imported here from Saigon two years ago. They are from first ratoons, and as the plants were not grown in soil suited to them, the joints are rather short.

"I received by steamer from Cochin China sixty plants, planted in soil, but only eleven survived the journey.

"The information given by my correspondent was to the following effect:—

"'These canes grow well in strong and damp land. When at maturity, they attain a height of from ten to twelve feet, and the juice has a density of 10° Baumé; but as they have hitherto only been cultivated by the natives, we are not able to give any information as to the amount of sugar obtainable per acre.'

"The eleven plants which I received alive yielded me in first cuttings five hundred new plants, and these I distributed among various planters.

"I intend to plant in May my second crop of cuttings, near to my Concretor works at Gripon; and next year I hope to be able to make a trial on a sufficient scale to be quite assured as to its true value."

The gain that may accrue to the West Indies from this act of M. Lauriol may be great, but his zeal and intelligence are too well known to require pointing out in your columns.

The plants about to be transmitted to Antigua this week are destined to be planted on one of the Belvidere group of estates. It is intended to furnish you with a report on them when they have attained maturity.

Yours truly,

Alfred Fryer.

Guadeloupe, March 11th, 1872.

FRENCH PATENTS.

From "La Sucrerie Indigène."

8999. 16th May, 1870. M. LALANDE. *Improvements in Centrifugal Process for Manufactories and Refineries.*

The object of this patent consists in an apparatus designed to divide and break up the mass of sugar which proceeds from the crystallization tanks, to mix it with water, sprup, or steam, and to send it into the centrifugals in a continuous stream, without having occasion to empty it into the machine by means of buckets, as is generally done. The sugar is placed in a hopper, where it is mixed with water or syrup or else with steam, which is conveyed through a pipe. From this hopper it passes into a mixing machine, the bottom of which is formed of bars, betwixt which pass the knives of a horizontal turning shaft, and it is completely reduced to the state of a very homogeneous liquid paste, free from lumps, in a revolving cylinder furnished with paddles. From here it is led to the top of centrifugals by wooden or iron shoots. The passage into each of these is regulated by means of a lever-slide, which the operator has under his control. A dripping tin ensures against loss, and allows of the greatest cleanliness being preserved round the machine.

90387. M. HAENTJENS. *Purification of raw syrups, beet or colonial, as well as the low products of the refinery or sugar manufactory.*

Given some sugar, beet or colonial, crystallized or of fine grain, of very inferior quality; it is mixed in a vessel provided with knives, with the washing water of the filters or of syrup, in such a manner as to form a homogeneous paste. This operation may be performed at such temperature as seems best suited, varying with the nature of the sugar.

The paste thus formed is thrown into vessels in the shape of truncated cones, of which the small end forms the bottom, which has at its centre a tube provided with a tap, branching from a reservoir communicating with an air pump.

At three centimetres above the bottom of the cone or vase is placed a very fine wire filter.

Each vase may contain nearly 100 cubic centimetres.

Immediately the action of the air pump takes place, the clearance is begun either with filter washings or diluted syrup—with lime water for colonial sugar, or with common water for beet sugars. These soon become saturated, and there is only a very slight waste. The "*clairce*" drawn through by the air pump removes the salts and the foreign matters contained in the paste, the passing away of which has been prepared by the mixing.

The clarifying is repeated as many times as is needful, according to the purity and the colour which it is desired to obtain.

HAVANNA AND MATANZAS.

EXPORTS FROM THE 1ST OF JANUARY TO THE 3RD OF MARCH,

(From Licht's Monthly Circular.)

	1872. Tons.	1871. Tons.	1870. Tons.
To United States of N. America ..	35,277	28,405	31,187
,, Great Britain	3,923	7,735	27,265
,, France	....	2,221	4,875
,, Spain......................	4,421	5,465	11,570
,, Northern Europe............	1,644	854	2,026
,, Southern Europe............	....	25	300
,, Other Countries	832	751	1129
Total......	46,097	45,456	78,352
Stocks in Havanna and Matanzas ..	57,436	58,325	92,826

MAURITIUS.

EXPORTS FROM 1ST AUGUST TO 5TH MARCH.

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
To England..........	32,891	13,287	29,534
,, France	13,538	5,177	11,155
,, Australia	19,775	27,493	30,604
,, Bombay..........	22,600	14,408	27,686
,, New Zealand......	2,833	2,793	3,344
,, Cape of Good Hope..	860	1,809	1,267
,, Other Ports	5,329	579	757
Total..........	97,826	65,546	104,347

ESTIMATED PRODUCTION OF THE PRESENT BEET-ROOT CROP OF SUGAR COMPARED WITH THE TWO PREVIOUS SEASONS.

(From Licht's Monthly Circular.)

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
France	320,000	289,083	289,324
Germany (Zollverein)	182,500	262,986	217,192
Austro-Hungary	167,500	182,280	151,354
Russia and Poland	90,000	135,000	132,500
Belgium	75,000	55,739	43,552
Holland and other countries	25,000	17,500	12,500
Total	860,000	942,588	848,422

STOCKS OF SUGAR IN THE CHIEF MARKETS OF THE WORLD ON THE 1ST MARCH, IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	1872.	1871.	1870.
Great Britain	110	105	93
France	74	121	135
Germany (Zollverein)	29	44	40
Holland	44	18	26
Six other Ports	5	4	4
Total in Europe	262	292	298
United States of N. America	39	51	73
TOTAL	301	343	371

CONSUMPTION OF SUGAR IN EUROPE AND THE UNITED STATES, FOR THE YEARS ENDING 28TH FEBRUARY, IN THOUSANDS OF TONS.

	1872.	1871.	1870.
Great Britain	692	702	642
France	321	325	299
Germany (Zollverein)	220	215	224
Holland	22	29	27
The six other chief Countries	118	90	111
Total in Europe	1,373	1,362	1,303
United States	549	477	413
TOTAL	1,922	1,839	1,716

SUGAR STATISTICS—GREAT BRITAIN.

To 20th April, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	4	1	2	7	14	16	11	2	3	10	27	35	19	2	2	12	36	44
British East India	3	1	..	..	4	12	4	2	..	..	6	3	4	4	..	..	8	9
Mauritius	3	..	1	1	6	3	7	2	8	5	22	6	6	2	8	6	23	6
Cuba	1	1	1	5	8	7	..	2	4	3	9	8	3	1	3	3	10	14
Porto Rico, &c. ..	1	2	..	..	3	3	..	3	..	..	4	3	1	3	..	..	4	7
Manilla & Java ..	13	8	..	3	24	36	11	6	2	7	26	16	10	8	2	5	24	21
Brazil	1	11	1	5	17	17	1	16	3	7	27	23	1	13	3	7	24	17
Beetroot, &c.	7	..	1	3	11	14	9	6	3	25	43	56	7	8	4	29	49	57
Total, 1872 ..	32	25	5	24	87	107	43	40	23	56	162	150	51	40	23	63	178	179
Total, 1871 ..	55	31	5	16	20 decrease		46	34	16	54	12 increase		60	37	18	65	1 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKETS.

The improvement mentioned in our last has not only continued, but has greatly increased during the month of April. The markets have at times been active, especially so during the latter half of the month. The stocks in London are remarkably low, so that the chief business done has been in cargoes afloat, which have generally sold at full value. Prices are from 1s. 3d. to 1s. 6d. above our last month's quotations. No. 12 Havana, afloat, sells for 30s. 6d. per cwt., and Cuba Muscavado at 28s. to 28s. 6d., Middling to good Brown Bahias are worth 25s. to 26s., and Good to Fine Brown Pernambuco, 26s. to 27s. Of West India, low to middling brown is quoted at 30s. to 31s. 6d., duty paid, and fine grocery and crystallized, 35s. 6d. to 39s. Refined sugars of various classes have fully maintained their relative value with that of raws. Common refined lump is worth from 42s. to 42s. 6d. per cwt. in London.

Imports have decreased during the month, from the beginning of the year the increase to the 20th of April is now only 12,000 tons as compared with the same period in 1871. Deliveries up to date have been very nearly the same as last year. Stocks have considerably decreased during the month, and are now 20,000 tons less than at the same date in 1871.

There is no improvement in the accounts from the West Indies and Cuba. In Brazil the crop appears to have been in excess of that of last year, as is also the case in Mauritius and Reunion. There are good average crops in Java, Manilla, and the East Indies, but not sufficient to make up the deficiency in the general stocks, and in the crops in Europe and elsewhere Unless supplies reach this country from unaccustomed quarters, we see no reason why the firmness which now characterizes the market should not continue for some time.

THE
SUGAR CANE.

No. 35. JUNE 1, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

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HINTS ON THE MODE OF WORKING THE CONCRETOR.

The introduction of the Concretor into many of the sugar growing colonies and countries has been so rapid, that up to the present time, sufficient sets of plant of this apparatus have been exported to provide this country with more than a tenth of all the sugar consumed in it.

Thus the imports of concrete have been large and are steadily increasing, and many refiners purchase concrete, having found the advantage of working it, and in fact, good concrete is the best of all sugars for refining, being free from dirt, containing little uncrystallizable sugar, and no caramel.

Those persons who have examined the samples of concrete, as they have been placed on the market, must have especially noted the widely different qualities that are classed under the same general name. These vary from a low dark sugar to dry light-coloured concrete, which when crushed most nearly resembles No. 11 Havana sugar.

The condition of the cane juice affects the quality of the concrete to a considerable extent, but the quality is also affected by care in working the apparatus.

In order the better to appreciate the points needing attention in working the Concretor it may be well to consider the end sought in its use, and the methods adopted for the attainment thereof.

The object sought is the evaporation of the water from clarified cane juice, so as to place the sugar in a solid form without injury to its colour or chemical composition.

Cane juice is an organized substance very subject to injury by fermentation and by exposure to heat. It consists almost entirely of sugar and water, usually in the proportion of one part of the former, by weight, and four of the latter. When raised to the boiling point of water and maintained at this temperature it becomes deepened in colour and injured in its chemical composition: and a portion of the sugar becomes thereby transformed or degraded into inverted or uncrystallizable sugar. The amount of these changes for equal temperatures and similar juice is directly proportioned to the time, that is to say, increase the duration of exposure and you increase the mischief. If the juice be acid the transformation into uncrystallizable sugar will be proportionately more rapid; if alkaline this alteration will be checked but the injury to the colour will be more marked. Boiling cane juice, while thin, shews no tendency to adhere to the vessel in which it is evaporated and the mischief depends entirely upon the heat of the liquid, and the time during which it is subjected thereto, and is not at all affected by the heat of the vessel or the fire or steam which communicates heat to it.

Ebullition takes place from the surface of the vessel when the heat transmitted is greater than the fluid in contact with it can receive without being raised beyond its boiling point. The excess is then employed in converting a portion of the water into steam, and bubbles ascend through the liquid. The temperature of the liquid at such a time is dependent upon its nature and density and also upon the pressure exerted upon it, firstly, by the atmosphere, and secondly by the hydraulic pressure due to the depth of liquid in the vessel. Thus a depth of two feet of sugar solution elevates the boiling point about three degrees Fahrenheit.

The writer has found that very shallow layers of sugar solutions boil freely at temperatures lower than their normal boiling points. This circumstance admits of explanation in the following manner.

If the boiling takes place in a deep vessel, say for example one foot cube, and nearly filled with cane juice, the evaporation after boiling point is reached will be conducted somewhat in the following manner. A portion of vapour will be liberated into the air from the surface of the heated fluid; by this means the surface layer will be cooled, and becoming heavier will sink, permitting a further supply of heated fluid taking its place. Thus the mass of fluid would be cooled if the temperature were not constantly maintained from the heat transmitted through the bottom of the vessel. Suppose for example one ounce of water be thus evaporated from the surface in thirty minutes. At the same time however, water will be converted into steam at the bottom of the vessel, say at the rate of five ounces in thirty minutes. The bubbles of steam will ascend through the water which will have been cooled by surface evaporation, and the steam from one ounce of water will be condensed in the process of maintaining the temperature at the boiling point whilst the steam from the remaining four ounces will escape into the air. Next consider the case of ebullition in a vessel one foot square, the depth of the liquid being only three eighths of an inch. The evaporation will proceed from the surface as before, say one ounce in thirty minutes, and steam will be generated from the bottom of the vessel as before, say five ounces in thirty minutes, but each bubble will have passed the mass of fluid into the air when it has forced its way upwards through only three eighths of an inch of fluid, or *only one thirty second part* of the journey accomplished by the bubbles in the deeper vessel. The bubbles have not in consequence sufficient time to heat the liquid to its normal boiling point, and its temperature falls until its powers of condensation are increased sufficiently to condense the amount of steam needed to maintain it at this lower point.

From the foregoing considerations it will be evident that if the concentration of cane juice is to be conducted in the open air

1st. It should be free from acid.

2nd. It should be free from alkali.

3rd. It should be boiled as rapidly as possible.

4th. It should be evaporated in very shallow vessels.

And in order that each portion of the liquid may be under treatment for the least practicable time—

5th. It should be evaporated in a continuously flowing stream.

When all these precautions are attended to, the amount of mischief caused by the degree of heat and the time during which the juice is subjected to it, is in fact *inappreciable*, unless the concentration be carried so far that more than three out of the four parts of water associated with one part of sugar are driven off. As the juice increases in density it acquires a tendency to "burn to" the evaporating vessel, the bubbles increase in size, and they leave the bottom of the vessel with difficulty. This tendency is increased in proportion as intense heat is applied, because the boiling is not sufficiently free to convey away the heat of the vessel in the form of steam. The bubbles instead of being liberated to make way for fresh syrup to flow instantly over their place and take away further heat, adhere to the heating surface, which itself becomes more and more heated. This difficulty in removing the heat is still increased from the circumstance that much less water is present. At first, four parts of water were associated with one part of sugar; now three-fourths of the water have disappeared, and the evaporating power of each pound of water is clogged by the presence of a pound of sugar. In addition to this, the boiling point has risen with the increased density. If, however, in proportion as the juice becomes thick, a less heat be applied to the evaporating vessel, the reduced power of evaporation will still be competent to remove the heat from the vessel, which cannot in consequence become so heated as to cause the sugar to burn to it, and the quieter ebullition will keep the boiling point as low as practicable. Thus it will be evident,

6th. That whilst a very hot fire can be applied in boiling the weak juice not only with impunity but with advantage, it becomes important to reduce the heat in proportion as the juice becomes thickened.

Boiling the juice by means of reduced heat, and in thin layers, cannot be pushed with impunity beyond the point at which six pounds of sugar are associated with four pounds of water. The tendency to burn and the elevated boiling point forbid it. Therefore,

7th. The process of concentration should be completed at a low temperature, and heat should not be conveyed to the thickened syrup through heated metal plates, to which it may burn.

In the Concretor the aforesaid seven conditions are supposed to be satisfied in the following manner:—

The juice having been well clarified (1 and 2), it is allowed to flow through a gauge vessel (by means of which the speed of flow may be kept uniform, and its exact volume noted) upon (3) the first of three wrought iron trays, on the under surface of which the full force of the most intense fire that can be maintained is directed. The juice kept to channels (4 and 5) which lead it backwards and forwards across the tray, as well as in a gentle descent away from the fire, is boiled in the most violent manner; and though the trays are filled with a mass of foaming bubbles, the juice itself steadily pursues its sinuous course down the trays. These wrought iron trays are maintained at a very slight inclination, so as to retain a sufficient body of juice upon them to guard against the risk of their becoming dry. When the juice emerges from the last wrought iron tray it passes upon the cast iron trays, down which it zigzags until it flows from the lowest one, at a density of 30° B., hot. The cast iron trays are arranged with a uniform slope in every part of the channel, which slope is greater than that of the wrought iron trays. As the thickened juice is less mobile than the thin juice, the slope of the cast iron trays is required to be greater. The upper face of the cast iron trays is grooved, so as to offer a greater surface for giving out the heat to the syrup than they present on the under side for absorbing it from the heated gases in the flue. The grooved surface also permits the bubbles to form and escape in the thickened juice more easily than from a smooth surface. In order to cause the intensity of the fire to be expended upon the upper trays, and to mix up the gases in the flue and force them upwards against the under surfaces of the trays, a series of low sloping walls is built in the flue, each extending from the side to the centre, and from each side alternately. By this device, and by placing the fire under the thinnest juice, it is possible to maintain the most violent ebullition upon the wrought iron trays, and (6) a less and less tumultuous one afterwards, until the last tray is passed. The residual heat or smoke passing through a series of narrow cast-iron tubes on its way to the chimney, raises their temperature sufficiently to heat large volumes of air (drawn past them by means of a fan) to a temperature of 250° or 300° F. The thickened juice after leaving the lowest tray enters a small tank, from which it is drawn off through a second gauge vessel to the cylinder. This cylinder has a length equal to about twice its diameter. Each end has a circular opening equal to three-fourths its diameter, and the interior is occupied by a large number of spiral blades extending from the axis to the circumference.

The syrup enters at one end, and as the cylinder is maintained in slow revolution all the blades are kept covered with the concreting syrup, which emerges as concrete from the other end. This effect is produced by a blast of air, heated as before described, being impelled through the cylinder in a direction contrary to the course of the syrup. The cooling effect produced by this rapid evaporation is such as (7) to reduce the syrup to a temperature of 140°, and this heat gradually rises as the syrup thickens, so that the issuing concrete is maintained at a temperature of 180° to 200°. The Concretor is so proportioned that the air heater furnishes an ample supply of heated air to concrete the syrup, and the fan and engine readily bring the heated air in contact with the syrup.

The effects produced by inattention to the rules for working the Concretor may now almost be anticipated. They are as follows:—

Muddy juice will be converted into dirty looking concrete.

Acid juice will give a concrete of good colour, but charged with uncrystallizable sugar.

Alkaline juice will be converted into dark concrete.

If air be admitted into the furnace mouth, the boiling on the wrought iron trays will be checked and fuel will be wasted.

If the furnace be not cleaned out as frequently as needed, and the clinker of megass ash removed from the bars, the fire will become dull and the work performed will be lessened.

If the damper be opened too widely the syrup on the lower trays will boil too violently, the air-heater will become too hot and fuel will be wasted.

If the crust be not removed when needful from the under surface of the trays and the scale also removed from the upper surface, the work of the trays will be lessened, and the air-heater will become too hot.

If the joints between the saddle pieces and the edges of the trays on which they rest become broken and open, air will be drawn into the flue, the amount of work reduced, and fuel wasted;—and at times flushes of boiling syrup will be drawn into the open joint, and sugar wasted.

If the side taps do not point precisely into the channel, but direct the juice from them in part against the top or the sides of the hole left in the tray, part of the juice will run over and be wasted.

If the attendant be not careful to feed the top tray with sufficient juice, and to give a little additional supply from one or other of the side taps, when the syrup on the trays tends to become too thick, a portion of the syrup will leave the trays too dense, and such syrup will make concrete of proportionately less value. When juice is boiled on the trays at a greater density than about 30° B., injury is produced by the scorching previously described. If the air entering the cylinder be too hot the concrete may be scorched,—if too cool the concrete will emerge at too low a temperature to set hard in the hogsheads.

If the concrete be discharged too soft it will drain in the casks, if too thick it will clog the discharging shoot.

If the fan and cylinder be not maintained at sufficient speed, air will not be drawn through the cylinder to concrete all the syrup, and the same effect will be produced by preventing the air from the fan from getting freely away, or by allowing the cylinder to be partially clogged up with solid concrete. In any of these last three cases the diminished power of the cylinder will be compensated by the trays performing increased work; the syrup will then leave the trays at 35° B. hot, instead of 30° B., and the injury produced by scorching on the trays will materially reduce the value of the concrete.

If the cylinder from any cause be unable to perform its share of the work, or if the juice be suffered to flow irregularly or too rapidly over the trays, the tank will receive more syrup than the cylinder can take away, and will become filled; the syrup will then need to be returned to the trays by the pump, and this will darken the juice. When the Concretor is properly worked the pump is rarely used.

If concrete be potted in thick layers it will remain hot and darken in colour.

If smoke be drawn into the cylinder the concrete will be discoloured.

The following rules have been found (from several years' experience) needful to be kept in view at Belvidere Concrete Works, Antigua.

MILL.

1. Keep cane carrier well and evenly fed, no place being suffered to be thin and none heaped up too thickly.

2. The megass returners to throw back all pieces exceeding one foot in length.

3. Megass shed to be frequently inspected to see that the megass made since previous examination has been properly pressed.

4. Teeth of pinions to be kept immersed in box of lubricant.

ENGINE.

5. Speed to be controlled by governors, not by link motion.

BOILERS.

6. Boilers to be kept well fed with water, and engine not to be permitted to run in order to drive feed pump alone, nor to work down steam.

7. When steam escapes from safety valves, damper to be lowered. Furnace doors on no account to be left open.

8. Tubes of multitubular boiler to be swept every morning.

CLARIFIERS.

9. Note that steam is on mill bed and lower rollers, and that the juice enters "Lung"* about 110° F. (hot to the hand.)

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* This piece of apparatus takes its name from its possessing a very large heating surface. The stream of juice enters from below, and flows away

10. Juice to leave lung at 170° F.

11. The temper lime for each clarifier having been weighed, to be slaked in a bucket with a small quantity of hot water, and afterwards diluted to milk of lime, which is to be poured, a little at a time, into a vessel with small orifice, so placed as to allow the lime water to flow in a nearly continuous stream into the channel leading the juice from lung, so that the acidity of the juice will be neutralized as the clarifier is filling. Each clarifier to be tested with litmus paper, no trace of acidity to be left; the flocculent matter caused to separate, and the amount of lime to be increased if needful until the juice shall leave the Concretor trays neutral.*

12. The clarifiers to discharge into the supply tank through the quieting vessel.

13. Every morning the lung, clarifiers, supply tank, gutters, mud gutter, filter heads, and filters inside and out, to be thoroughly washed, the pipes leading to the Concretors being plugged. Every night, mill, mill bed, tank, and pipes, to be washed, and rinsed with lime water.

14. All scum and dregs from clarifiers, washings from supply tank, and skimmings from Concretor trays, to be put immediately into the scum defecator, made distinctly alkaline, boiled vigorously for five minutes with open steam, and passed into the

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from the top; it is heated by waste steam. It discharges the juice into the clarifier at any high temperature that may be desired, and thus the process of clarification is completed expeditiously. Its use reduces the number of clarifiers needed, and by permitting more time for subsidence increases the brilliance of the juice. Measured by the heating surface it is less costly than a clarifier, and its effective power is much greater than that of a clarifier, as its heating surface is in constant use instead of being idle for three-fourths of its time. At Belvidere it is used in conjunction with tubular steam clarifiers, but when used with plain steam-heated clarifiers it renders them highly efficient. It is the invention of the writer, and made by Manlove, Alliott & Co.

* Carefully clarified and neutral juice will often acquire acidity as the process of concentration proceeds. Mr. Spencer Hollings states, that a less quantity of lime is needed to neutralize this when it is applied in the first instance in the clarifiers, than when the juice is made neutral in the clarifiers, having further portions added to the juice as the concentration proceeds.

bag filters, which are to be used alternately, one being kept constantly packed ready for use. The bags when fouled, to be emptied, washed, boiled, and then rinsed in weak cold lime water.

CONCRETORS.

15. Every morning, before Concretors are used, the trays and sides to be well washed and scrubbed down, if not so treated the previous night. Every night, after the last juice has left the supply tank, *all* the side taps to be opened, and to remain open until the following morning.

16. Skimmings from Concretor trays to be taken to bag filter. Skimmings from Concretor syrup tank to be placed in a strainer above tank, the contents of which are to be taken to channel leading from lung, unless required for cattle food. The deposit from bottom of syrup tank to be removed weekly (or more frequently if needful) to the channel leading from lung.

17. The cylinder of Concretor to be thoroughly cleaned out either last thing at night or first thing every morning.

18. Air heater tubes to be brushed out once every three days, or more frequently if needful.

19. Every three weeks megass ash to be removed from flues, and deposit from under air heater, and loose crust which adheres to under surface of trays to be scraped away; the lime deposit on upper surface of trays to be scaled when needful.

20. Note that no air is drawn into the flues at saddle pieces, copper connections, at higher end of uppermost tray, or elsewhere. Test by putting damp fuel in fire and closing damper, noticing where smoke exudes. If joints of saddle pieces have opened close them carefully with cement.

21. The damper to be in constant use and opened widely, when fire is made, and when the trays boil freely check the fire, and *always work the Concretor with damper as close down as practicable.* With good fuel it will not usually be more widely open than about two and a half inches. The man who has charge of Concretor cylinder to attend to the damper. Fire to be maintained clear, intense, and regular, and concentrated as much as possible upon the upper trays. *The furnace mouth never to be left open.* The amount of air admitted at the furnace grate to be sufficient to produce a

very light smoke. Too little air produces a dense smoke which coats the tubes of air heater. Continuous absence of all smoke shows that too much air enters the furnace.

22. Juice to leave trays about 30° B hot. Air to enter cylinder 280° to 300° F. Concrete to be discharged in small quantities frequently, in preference to large quantities occasionally. Temperature of concrete 180° to 200° F. When the juice is good the concrete should be pretty stiff and flow with difficulty, dropping in flakes or masses. When juice is bad it will be more fluid. No obstruction to be offered to air leaving fan.

23. No layer of concrete in the hogsheads to exceed half an inch in thickness. A less thickness is still better. As many hogsheads to be filling at the same time as will ensure the mass in each remaining quite cool. The bulb of a thermometer plunged in to a depth of six inches should not be heated beyond 110° F. The blade of a table knife or a piece of quarter inch wire with pointed end, will furnish a ready means of testing the heat, if a thermometer should not be at hand.

24. Any concrete of dark colour to be placed in separate casks and differently marked. Qualities to be kept separate as much as possible.

25. Occasionally test that no smoke escapes into the air-heater in consequence of sand joints having been disturbed, or heater tubes broken. Put damp fuel on fire, shut the damper, and notice whether smoke can be seen or smelt at the fan when in motion.

26. Admit abundance of light and air to all parts of the Concretor and KEEP EVERYTHING CLEAN AND SWEET.

The Concretors at Belvidere have received several modifications, which, though slight in themselves, have proved useful. They are as follows:—

A. The grate area of the furnace has been contracted to twelve square feet. The fire bars of wrought iron made by Manlove, Alliott, & Co., are narrow and deep, with wide air spaces.

B. All the baffle walls have been raised six inches, and the area of the flue under the lowest wrought iron tray, has been reduced one third by building a low wall across,

C. Small pieces of wood half an inch deep and one inch broad have been placed on the cast iron trays at the extremity of each channel. These charge the channels with rather more syrup, the density of which changes less rapidly from variations in the heat of the fire; and as the lower surface of the wood is not grooved to fit the corrugations of the channel, the trays drain empty when the supply of liquid is arrested. It is intended to replace these stops with neat castings specially designed, and easily removable.

D. The pump is disconnected from the auxiliary juice pipe and discharges into an open channel which leads to the second, third, fourth, or fifth tray from bottom, as may be desired.

E. Clay is substituted for sand as the lower layer for packing the upper and lower end of heater tubes. This burns to a brick and makes a good bed for the layer of sand. The brick may be easily broken away when the pipes need to be removed.

F. A water pipe and tap should be fixed about one foot clear of the upper gauge vessel, and one foot above it. A short piece of iron pipe should be attached to the tap, by means of a small piece of indiarubber pipe or leather hose. Beneath this, and ready to catch any droppings, a bucket should stand on a shelf made of a couple of bars of wood or iron, and by its side a second bucket should be placed, and both should be two-thirds filled with water. After the last juice has left the supply tank the pipe may be laid in the gauge vessel, and water run over the trays. If from any accident the flow of juice should at any time cease, water can be put upon the trays, and the buckets afford the means of throwing a few gallons upon the lower trays in such an emergency.

Each Concretor of the largest size requires three persons (negroes) to work it properly, in addition to the girls, who carry off the concrete to the hogsheads. They are

1. The "Cylinder-man," who has charge of the cylinder and damper. He keeps the engine clean, regulates its speed, and daily cleans out the cylinder. He regulates the flow of syrup into the cylinder, increases the heat of air, when needful, by raising the damper "a hole or two," or checks it by lowering the damper, and if needful, opening the small door at top of the air

connecting piece. He removes the scum from syrup tank, regulates the flow of concrete, and takes the general charge of the Concretor, and the control of his assistants (See 2, 3, and 4). Wages, one shilling and fourpence per day.

2. The "TRAYMAN," who regulates the supply of juice to trays, and removes any scum that may form on the upper trays. If the juice should thicken too rapidly he admits an additional supply for a few moments by means of one more of the side taps. He sees that the syrup leaving the trays is of uniform density, putting on the pump should the tank become filled. He has to assist the girls in washing the trays by scraping away any deposit; and he and the stoker have to clean the heater tubes. He has control over the stoker to ensure the maintenance of a clear, brisk, fire. Wages one shilling per day. This work, with the exception of aiding to brush out the heater tubes, may be performed by a woman, whose wages amount to tenpence per day.

3 The "STOKER," who has to maintain a clear, intense, fire, removing the megass ash clinkers as often as they accumulate. To clean out ash from flues and to assist the trayman to brush out heater tubes.

4. The "GIRLS" carry off concrete to hogsheads. They wash the trays, the Concretor-house floor and upper floor of cask-house each day, and sweep up when needful. Wages tenpence per day each.

The boiling-house overseer exercises a general oversight.

If two Concretors fed with juice from the same tank produce concrete of different colour it is certain that the one making the darker produce is out of order. If the fire be maintained vigorously and equably, and the heated air be at about the right temperature it is almost certain that the cylinder is at fault, either partially choked, or the fan is not working up to speed, or the air is not escaping from it freely. If the thermometer in the air heater connecting piece have not the bulb plunged fairly in the current, or if air be suffered to be drawn in upon the bulb through the hole into which the bulb is introduced, the reading of the thermometer cannot be relied on. It also misleads when the top door of the hot air connecting piece is open.

It may appear from all these regulations and cautions that the working of the Concretor is difficult. Such, however, is not the case. To work the Concretor in the best manner two requirements must not be neglected—CARE and CLEANLINESS; but with these and a knowledge of the principles on which the Concretors are based, an entire stranger to all sugar processes can use the Concretor with ease and complete success. Such a one could *not* stand, proof stick in hand, before the vacuum pan, or attempt to manipulate the numerous taps studding the network of pipes which entangle the "*triple effet;*" nor would he fare any better were he to attempt to take off a strike in the battery. The five Concretors in Antigua are solely tended by negroes, under the general direction of the overseer.

Whilst the Concretor, if mismanaged, may like any other piece of apparatus yield a product of any degree of badness, yet, if properly managed, produces a result superior to any process whatever, taking QUANTITY, QUALITY, and COST into account. I have lately brought samples of *masse cuite* from the vacuum pans of the finest French Central Factories in Guadaloupe. The juice composing these had been passed twice through animal charcoal and boiled in four successive vacuum pans at an expense, which those who have not examined the process and looked into the figures will scarcely credit.

I have also a portion of concrete made at Belvidere to compare with it. In this case the syrup was passed through a common bag filter and the concrete was discharged at the lighter density of *masse cuite*. The concrete is better in colour than the *masse cuite* of the *usines*. The reason is not far to seek. The syrup in the *triple effet* and vacuum pan has been tortured for many HOURS during which heat has been conveyed to the thickened syrup through metallic plates, and the mischief thus produced has not been counterbalanced by the double charcoal filtration.

In the case of the concrete, the juice has in a few MINUTES been concentrated to the same extent and no injury whatever has been inflicted.

ALFRED FRYER.

ON THE MANUFACTURE AND REFINING OF SUGAR.

[*The Cantor Lectures, delivered before the Society of Arts.*]

By C. Haughton Gill.

(Continued from page 255.)

Lecture V.

I now come to the last branch of my subject. Having treated of the preparation of the raw material from its two main sources, viz., the sugar cane and the sugar beet, I have now to describe, but in outline only, one of the processes employed in the refining of that sugar, so as to render it fit for consumption. Many of these samples of raw sugar that I have laid before you are really quite uneatable; indeed, I was told this evening that one sample I had left here had been used for making a pudding, which had to be thrown away. It was a specimen of low, raw West Indian sugar, containing some 2 or 3 per cent. of sand, and naturally, therefore, the pudding made with it was somewhat gritty.

The sugar refiner has to deal with this raw sugar, and his business is simply to cleanse it—in fact, the sugar refiner has to take dirty sugar and make it clean. And I propose this evening to tell you one process by which he does it, for there are variations in the methods employed, and perhaps no two sugar refiners work in precisely the same manner. I can only, therefore, tell you an outline of what takes place in one set of refineries, and I propose to choose those which turn out their main product in the form of loaves, such as I have placed upon the table.

In the first place, I must tell you that the sugar which the refiner has to deal with is, of course, of two sorts, cane sugar and beet sugar, as the case may be, but it makes no difference to him which he employs. Refined sugar, from whatever source it is made, has identically the same properties, and, in fact, cannot be distinguished by any means I am acquainted with. Before entering on the details of the work performed in a refinery, I must mention again what I have previously implied with regard to the nature of raw sugar. In both cases, if you recollect, the more or less purified juice of the cane or the beet respectively has been evaporated with greater or less precaution, to avoid the destructive action of heat and acids, until the solution became a hot saturated solution, and, that then the sugar has been caused to crystallize in one way or another. In any case, the sugar crystallized in the concentrated solution somewhat quickly, and, as you saw by the samples I produced, the crystals were small and confused. Now consider the conditions under which they have been formed. They have grown in a solution which contained not only sugar and water, but also a good many impurities, including saline combinations and albuminous bodies, and, at any rate, in the case of cane sugar, very often a considerable amount of actual solid impurities, feculencies of one fluid or another, the *débris* of plant-cells which had remained in the liquid, never having separated from it, and which, therefore, remain ultimately hanging to the small crystals of sugar formed in the syrup, which consists of sugar, water, and various gummy and other bodies, of which the nature is practically not known.

The syrup surrounding these crystals is of a very sticky nature, and when the mass, consisting of grain sugar and syrup, is allowed to drain slowly by itself, or when it is put into a centrifugal machine, such as I showed you last week, still the syrup is not perfectly separated from the grains of sugar. Each individual grain of sugar remains wet with the syrup, which syrup is obviously not a pure solution of sugar, and, therefore, the material which is won in this way is not pure sugar. Even if the crystals themselves were quite pure, their remaining wetted with a solution which is not that of pure sugar causes the material itself to be contaminated with various foreign bodies, which it is the refiner's duty to remove.

Now, the impurities adhering to the crystals of sugar are of two kinds—solid ones, which if washed and dried, would be described in ordinary language as mere fluffiness; and also soluble bodies, which were not removed in the processes to which the juice was subjected. The refiner gets the sugar containing these impurities, and his first operation is to dissolve that sugar in water.

This is generally performed in large circular cast iron pans, containing 4 or 5 tons of sugar, with a proportion of water sufficient to dissolve it, which is about half the weight of the sugar. I have so dissolved a quantity of raw sugar here, and it is by no means a bad specimen; still you see the solution is quite cloudy, indicating that there are solid bodies present which interfere with the free transmission of the rays of light. If the solution were simply coloured, but were free from solid bodies, it might look dark in colour, but still it would be transparent and bright. The refiner, then, has first to get rid of this solid matter, and the obvious plan is to pass it through a filter in the same way as I clarified a solution the other day, by passing it through a folded filter paper. But all these fluffinesses tend very rapidly to choke up the pores on any filter on which you can pour the solution, and accordingly it becomes very difficult to clarify the liquid simply by filtering. The difficulty is very often got over by a method which you have all heard of, and I dare say thought very nasty, I mean by the use of blood. Blood consists of two parts. When it is first drawn from the animal, if it is allowed to stand quietly by itself, it soon sets into a sort of clot; that arises from the passing of one constituent of the blood into a solid form; the fibrin, as it is called, becomes solid, and binds the whole mass into a clot—that is, if the blood is allowed to stand still. If fresh-drawn blood be stirred, the fibrin collects into a sort of thread, whence its name, and this can be all withdrawn from the mass, leaving behind a solution, somewhat coloured, of the other constituents of the blood, among which albumen, that is, the same body as the white of an egg, is the most important. I am going to show you the effect of putting this defibrinated blood into a solution of sugar. I might have used white of egg in the same way, but blood being more generally used (except in Russia), I thought I had better use it on this occasion, when you will see its effect in clarifying the solution. The solution ought to be at a temperature of about 120° or 140°. You can anticipate what will occur, if we mix a solution containing solid particles either with white of egg stirred up with water or with this albuminous portion of the blood and then heat the liquid to near the boiling point. You know that white of egg sets when it is heated. If I mix, therefore, albumen of the blood with this solution of the sugar, and then heat it up to the point at which the albumen will coagulate, there will be a sort of network of solid albumen formed, and that will entangle every particle of foreign matter in the solution, and, at the same time, there will be bubbles of air enclosed in it, and the mass will float up to the surface, forming a sort of scum. As it comes to the top it will carry with it the solid impurities contained in the sugar. I am now using a larger quantity than is used practically in sugar refining, for only two or three buckets full are used for several tons weight of sugar. After heating the solution to the temperature at which the albumen will coagulate, I will strain off the liquid, and I think we shall find that it will be, though still coloured, clear and transparent. When this has been performed in the "blow-up" pans, as they are called, and the liquid has been blown up and clarified in this way, the scum has to be separated from the liquid. This cannot be done on a large scale by allowing the mass to stand, and straining the liquid off through a pipe, but another and more perfect mode has to be adopted. That is done by pressing the whole contents of these "blow-up" pans through a series of bags made of twilled cotton cloth, each of which is placed inside another case of very coarse hemp material, which simply serves to hold the bag together, and being much smaller than the inside bag, causes the surface of the latter to lie in folds, which present a large filtering surface. On the table there is a specimen of one of these bags with its case; one end is attached to a pipe through which the liquid runs down and fills the bag below, and passing through the folds of the bag, it runs out clear, leaving all solid matter behind. The liquid that passes through these bags is, of course, highly coloured, if it is a solution of anything like ordinary raw sugar. There is a specimen on the table of the result.

The liquid now passes into a series of iron cisterns, where it remains until it is wanted. When almost boiling hot, it is run into the top of an iron cistern, like a large steam boiler turned on end—a vessel made of cast iron, perhaps 20 feet high by 7 in diameter, and capable of holding from 15 to 20 tons of animal charcoal. The liquor runs into the top of this cistern, which is nearly filled with animal charcoal, and gradually percolates downwards through it.

Now, I have shown you already one action of animal charcoal. You recollect that when a solution of dextrine passes through a column of animal charcoal, it loses its dextrine, and the solution of sugar in passing through the animal charcoal loses in like manner portions of the albuminous and gummy matter contained in it. But now I wish to show you another action which is very remarkable, and far more striking at first sight than the one I have mentioned. I refer to the power which animal charcoal has of absorbing from a solution many vegetable colouring matters. For the purpose of exhibiting this power I will choose a solution of high indigo, and show you its effect. The sugar, in passing through this column of animal charcoal, loses, in great part, the colouring matters which it originally had, and, at the same time, as I told you, some of the less visible but somewhat more important bodies of a gummy nature. Here are two solutions, one before going through animal charcoal, and one after, and you see the difference, though I have taken a not very favourable specimen, because the liquor had been running through for some time, and, therefore, the decolorizing power of the charcoal had become to some extent exhausted. It is a very important matter to the refiner to get the solution of a good colour, and, therefore, great care is taken in this process. Now, to show you the effect of the charcoal on the solution of indigo:—I might have chosen caramel, which is, practically, burnt sugar, or many other colouring matters, such as cochineal, and it would have shown the same result. On putting into this solution of indigo some powdered animal charcoal, and boiling the two together for some minutes, and then filtering the liquid, you see that the charcoal has removed the colouring matter to a very considerable extent; and the same effect is produced on the sugar liquid on passing it through these large charcoal filters.

From these charcoal filters, the liquor, which is now almost colourless, passes to a vacuum pan, the mode of action of which I have already described. The solution is concentrated there until it becomes a supersaturated solution. It is then caused to crystallize, and the crystals are made to grow in size by the admission of fresh portions of the liquor into the pan from time to time, and the evaporation of the water belonging to that liquor, until the pan is nearly filled with a mixture of grains of sugar floating in a hot saturated solution of sugar, *plus* the impurities which still remain. When the "boiler" judges that the mass in the pan is of sufficient strength, he stops the process of evaporation by simply shutting the valve which communicates with the air-pump, and causes the boiling to cease. He then allows the temperature of the mass to rise some 20 or 30 degrees. Now, what is the effect of raising the temperature? As I have stated, and shown to you by experiments, water has a point of saturation for every soluble solid at each degree of temperature, and, as a rule—at any rate it is the case with sugar—the higher the temperature, the more of the solid matter will dissolve. Now, we had here a mass of crystals floating in a syrup, saturated at a temperature, say 150° F. Now, on raising the temperature of this mass, the water present in the syrup becomes capable of dissolving an increased proportion of sugar, and accordingly some small portion of these grains, or small crystals, passes again into solution; the syrup becomes more concentrated at the same time that it becomes hotter. This heated magma of of crystals and syrup is now filled out as rapidly as may be into a series of moulds, which vary in size in different refineries. I have here a specimen of one of the smaller size, the shape of which will be familiar to you; they have an opening at the bottom, which can be readily closed or opened. In these moulds the mass is allowed to stand for a couple of days or so; first it stands for twenty-four hours, when it becomes entirely set into a hard cake. How is it caused to set?

(To be continued.)

THE ICERY PROCESS.

From Report presented to the Chamber of Agriculture of Basse-Terre,

By M. Aristide Lignieres.

Gentlemen,

The process of manufacture invented by Dr. Icery, of Mauritius, consists, as you know, in the employment of insoluble monosulphite of lime. It is distinguished from other processes in use: 1st. by the operation being conducted on the raw material at its natural acidity; 2nd. by the inert condition of the substance employed, the action of which is regulated by the degree of this acidity; 3rd. by the double power of defecation and decoloration which this body possesses under aforesaid conditions; 4th. by the insolubility of this body, which after its action is easily separated from the sugar liquor, and consequently can be no obstacle to crystallization; 5th. by the economical advantages which it affords in placing the required materials in the hands of the manufacturers themselves.

The sulphurous liquid which holds in suspension [?] the monosulphite of lime is produced by the burning of raw sulphur in a patented apparatus. Placed in the factory itself this apparatus gives in the best possible conditions, and to the required extent, all the monosulphite needful for the largest manufactories.

Besides, filtration by animal charcoal is replaced by a mechanical filtration through gravel or sand, or by subsidence. All sorts of filters may be used, and the decantation may be effected in any tank the operator chooses.

I will now, gentlemen, give you a brief account of the three trials which I have here made of this new process of manufacture.

It is long since the system of Pere Labat was in use in either Mauritius or Reunion, neither have I received any information as to the mode of the use of monosulphite of lime in these primitive apparatus. I was reduced, therefore, to the necessity of numerous trials. The following is the method of its use at which I eventually arrived, by being convinced that the new experiments gave the best results. Into the juice at the moment when it flows into the *grande* a quantity of monosulphite of lime is put, equal to 2 or 3 per cent. of the volume of juice which it contains. Then the operation is allowed to proceed as usual, until the juice reaches the 3rd copper. Then after the scum has been taken off as completely as possible, small quantities of clear milk of lime are added to the boiling liquor, in order that the acidity of the juice may be reduced to the right degree.

It is very necessary to take note of this proportion, because if the juice were too *acid*, or if it became too *alkaline* the results would no doubt be injurious. Still this operation, if delicate, is very simple, and the boilers would, after a few days' trial, find it easy to carry it out properly.

When the juice has reached a density of 25° B. it is taken from the battery to the subsider, where it soon deposits monosulphite, in fact all which it holds in suspension. On issuing from the subsider it goes into the boiling copper, whatever form may be used. At this moment it is perfectly limpid and of a clear light colour, and altogether comparable to the most beautiful juice filtered through animal charcoal. When placed in hhds. the sugar obtained is firm, does not sink down, and shows the ordinary results on the scale. The syrups which drain from it are very pure, and of a beautiful colour, and what is remarkable, when placed in cisterns they soon begin to deposit large crystals.

It is certainly in the reboiling of these syrups, that the planter will derive the greatest advantage from this process, because the glucose which is found in large proportion in colonial sugar disappears completely. As was stated by M. Dubrunfaut in an article in the *Moniteur Scientific*, of 15th May, 1870,

> "A Bourbon (Reunion) proprietor "says he" has submitted to me two samples of sugar one prepared by the usual method, the other by Dr. Icery's new process, which is based on the use of monosulphite of lime. We have ascertained to our great astonishment that the sugar from the Icery process very light coloured, and pure in taste, had the standard of nearly pure sugar and that it was quite free from glucose, whilst the sugar prepared by the ordinary process was very impure and glucosic."

The sample No. 1 which I lay before you has been valued at *Pointe á Pitre*, at 1s. 2d. per cwt. above good 4 ths. This estimate will not appear exaggerated if you take notice of the purity of the sugar. Dissolve it in a glass of water and you will see that in colour there is little difference between this solution and that made from the factory sugar No. 1. Sample No. 2 is exactly the same as the former except that instead of being drained, it has been centrifugaled. You will observe that it is quite white and may be compared as to colour with the beautiful seconds of the great factories. It does not possess the yellow or grey cast which centrifugaled sugars, those which have not been passed through animal charcoal, usually have.

In the Bourbon factories, where the evaporation and crystallization are carried on by the naked fire and at a low temperature, monosulphite of lime is used in the following manner. After defecation by this agent the scum is carefully removed and then small quantities of lime which has been previously slaked either with juice or with water are added until the degree of acidity is attained; it is then defecated afresh and the juice transferred to a subsider, whence it soon comes out pure and limpid ready to be sent to the evaporating apparatus.

It is very necessary in this process carefully to watch the development of acidity in order to reduce it, if it is excessive.

After two days' work at the Bourbon factory, Les Mineurs, where I made trial of the process, the sugar boiler acquitted himself wonderfully in this operation. As in the coppers of Pere Labat, the juice when evaporated to 25° was sent into the subsider to be thence transferred to the boiling apparatus. At the factory Les Mineurs, eight or nine hours are usually required to finish a charge in each Wetzel, whilst by using monosulphite of lime the boiling never lasted more than six hours and a half. It is further remarkable that the tubes of the Wetzel, did not as in the manufacture by lime and sulphite of soda, become coated with that hard white substance which takes so much trouble to remove. This is not surprising since the juice being completely defecated and purified by monosulphite of lime no longer contained dirt liable to adhere to the tubes, and the boiling of the sugar is from this cause alone more rapid.

Instead of subsiders, the filter presses of Du Rieux and Bœttger and Co., may be used the price of which in France is 3200 fr. (£128), for an apparatus yielding such operation 300 kilogrammes of pressed residue.

The results obtained at Les Mineurs are as satisfactory as could be expected from a first trial. Several amongst you, gentlemen, can testify to this. The sugar which was made and which was comparable to the finest 2nd class sugars of the great factories would doubtless have been worth as much as the samples 3 and 4 which I received from Reunion, and which I had the honour to submit to you, if it had been possible as Dr. Icery particularly recommends to give to every wrought iron surface in the apparatus at least two coats of paint, in order to prevent the formation of sulphide of iron. But it was necessary to take off the large crop which was to be operated on rapidly, and in the hurry only one coat of paint could be given, and then unfortunately one shoot had been forgotten. It is to this doubtless, that the grey tint of the sugar must be attributed. Nevertheless in spite of the defective colour the sugar was worth at least 7d. per cwt. more than the sugar usually made in this factory by means of the sulphite of soda, and it has further been proved that if on centrifugaling, the quantity of sugar produced by the new method is not greater, neither is it less; the same observation may be made as to the low products.

At the Clugny factory, by Canal, I have also applied the Icery process. It happened there that the plant obliged us to modify the use of the monosulphite. The operations were conducted in the following order:—

1st. Defecation by lime in proportions varying with the acidity of the juice.

2nd. Removal of the scum.

3rd. Second defecation, with monosulphite of lime.

4th. Passing the juice through the filters.

These operations altogether only take up the same time as in the ordinary manufacture. The proof of it is in this fact, which the director of the factory can attest, that during this trial, which had been made under his eyes and with his obliging assistance, there had not been less sugar made than usual.

I must however admit that the skimming by hand after the defecation by lime is relatively too long an operation, and was not in keeping with the splendid plant of the great factory; but I will add, that at Clugny even, I perceived during the trial that it would be easy to remedy this. In fact, there is nothing to prevent (after settling a short time in a subsider, which allows the greater part of the dirt to solidify,) the juice being drawn off by a special *monte jus* and conducted into the same or any other subsider, to be submitted to the action of the monosulphite of lime and the second defecation. This would not need more manual labour, but merely some taps with which this operation could be accomplished.

During these trials the filters were filled not with gravel or sand as Dr. Icery recommends, but with old charcoal washed in cold water and not revivified. This was a mistake. The director of the factory besides many other competent persons who assisted at the operations, soon acknowledged it. The sugars were not however spoilt by it. The samples which you have before you leave nothing to be wished, they are in all respects equal to the most beautiful sugars of the Clugny factory.

Here a very important question presents itself: that of return.

At l' Ilet a *Pere Labat* manufactory, and at Mineurs, a Bourbon factory, there was no difference in the returns. It was not the same at the factory of Clugny. We there remarked an increase in the return of the 1st crystallization and a decrease in that of the 2nd. But the formation of froth in the boiling apparatus was observed in the two trials. This froth was evidently occasioned by the presence of nitrogenous matter in the pores of the old charcoal not revivified, and which came in contact with the juice during the two filtrations to which it was submitted. Is it then to the employment of this old charcoal that we must attribute the diminished return? I am inclined to think so; because M. Mazerieux writes me thus: "In the factories of the island of Reunion 20,642 hectolitres, (45·4124 galls.) of juice have yielded :—

				s.	d.	
237	tons	of white sugar,	1sts, at	27	10	per cwt.
48¾	,,	,,	2nds ,,	26	3	,,
30	,,	,,	3rds ,,	21	4	,,
12½	,,	,,	4ths ,,	20	3	,,

Total 328¼ tons, or a return of 24lbs. of sugar to 22 gallons of juice, a return similar to that formerly obtained in this factory, of sugar No. 13 and below. It must be observed that the juice was from canes grown on marshy ground and that it was comparatively poor."

I must now tell you, gentlemen, what it would cost to employ the process in the different factories of our colony.

1st. Ordinary *Pere Labat* factories. I take, for example, one able to turn out annually 200 hhds. at least. The expense to be incurred in this would be:

	£	s.
1st. Cost of apparatus for making the monosulphite of lime	101	12*
2nd. ,, One subsider	52	0
3rd. Payment to Dr. Icery for 200 hhds.	100	0
4th. ,, M. Colongon for use of subsider	20	0
	£273	12

Then the sugars obtained by this process being valued at least 1s. 2d. per cwt. above good fourths, this extra value alone would nearly cover in the first year of the establishment, all the expenses which it has caused; and as one of the advantages of this new method consists in the reboiling of syrups entirely deprived of glucose, its use would leave, even the first year, a profit to the planter.

It is useless to remark on the expense of the production of monosulphite of lime, because it is insignificant. In Mauritius, and in Reunion, where Dr. Icery's system has been practised for some years, this expense is fixed at 12½ centimes, per 500 kilogrs. (about 2½d. per ton) of sugar.

It only consisted at l'Ilet in the price of the sulphur used, the workmen employed being able to lend a hand in its manufacture. It is true that it reached 10d. per ton at the factory of Mineurs and 1s. at that of Clugny, but here everything had been done in haste for the trial of the new process, and without regard to economy either in labour, or in the placing of the monosulphite apparatus.

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* The prices here given are those of the apparatus delivered in France, it is needful to take into account the expense of packing, of freight, carriage, and of setting up, about 8 per cent. of the value of the machines.

The expenses at Clugny have been calculated as under:—

		s.	d.
Materials used..	2¾ bushels of lime..........	2	0
	22 lbs. of sulphur	4	4
Manufacture....	1 skilled workman, 24 hours..	8	0
Carrying	2 labourers, 24 hours........	6	5
	Total for 24 hours..........£1	0	9

for the manufacture of 20 tons of sugar, a trifle over 1s. per ton.

If the apparatus had been placed at a convenient level, the expense of the two labourers employed to carry the monosulphite might have been saved, by the use of a gutter. Again, we believed that at the first trial it was necessary to have a skilled workman at 8s. to prepare the monosulphite, but we soon saw that a common labourer at 3s. 3d. would have been quite able, under superintendence of the manager, to do all the work. For the rest, we see no reason to prevent the preparation in Guadeloupe of monosulphite of lime as cheaply as in Mauritius and Reunion.

The expense of monosulphite is then insignificant, as I have said before. On the contrary, the planters use at present a rather expensive chemical to improve the produce of the *Pere Labat* apparatus; the chemical thus employed is sulphite of soda. Of the expense of this agent, which is not always successful, and which leaves the syrups in a state which renders their reboiling very difficult, it is needful to take account.

Its cost is 6s. 6d. per hhd., or £65 for 200 hhds.

2nd. Bourbon factory producing at least 600 hhds. of sugar; this establishment would need:—

1st. A monosulphite apparatus	£101	12	0
2nd. Two subsiders for juice from defecators	104	0	0
3rd. One subsider for juice 25°B....	68	0	0
Bounty payable to Dr. Icery on 600 hhds.	300	0	0
Bounty payable to M. Colongon for use of 3 subsiders	40	0	0
	£613	12	0

To the expense the establishment must add yearly that of the manufacture of monosulphite of lime, say 600 hhds. at 12½ centimes = £3.

If we then should obtain from the Icery process in Guadeloupe, merely the results of the trials which have been made at Mineurs, the Bourbon factories would make a good thing by adopting it. In fact, gentlemen, on the one hand they would economise what they now expend in sulphite of soda, and which for 600 hhds. at 6s. 6d. would reach per year.................... £196 16 0

On the other hand from sugar such as manufactured in March last (valued by those who assisted in the trial at 7d. per cwt. more than that made by sulphite of soda) they would gain on the produce of 600 hhds. of sugar, an extra amount of 360 0 0

Total...........£556 16 0

A sum which with £56 would nearly cover the disbursements of the first year, and by an annual expense of £3 for monosulphite of lime they would make in the account of the following seasons a profit of £556.

But it is not certain that this is the whole of the benefit they would derive from the new process. I have taken as the base of the calculations an increase of 1·50 fr. per 100 kilos (7d. per cwt.) as fixed during the March experiments. Evidently if the precautions directed by Dr. Icery had been taken and the wrought iron parts had received two coats of paint, the formation of sulphite of iron would have been prevented and the sugars manufactured would have been as good in quality as those from Reunion which I have shown you, and then in place of an increase of 1·50 fr. the increase in value would have been double at least.

And what besides would these factories have to do if they wished to adopt the new processes, [of the central factories] especially if they wished to produce such sugars as those of the samples 6 and 7 from Reunion. It would be necessary for them to adopt the double filtration of revivified animal charcoal and consequently to incur the following expenses:—

	£	s.	d.
1st. Cost of six filters @ £34 each	204	0	0
2nd. ,, one washing apparatus	60	0	0
3rd. ,, steam heater	48	0	0
4th. ,, furnace for revivifying charcoal with metal chimney and other accessories	268	0	0
5th. ,, supply of charcoal	233	12	0
6th. ,, steam engine for the workshop	120	0	0
7th. ,, miscellaneous expenses @ 8 °/o	74	13	0
Total	£1008	5	0

And to these expenses, double of those which are required by the Icery process, it would be needful to add annually, instead of 75 frs. (£3,) the cost of providing monosulphite, the enormous expenses of revivifying and replacing the animal charcoal, the production of steam, &c., &c., that is to say a sum which would probably exceed 4000 francs (£160.)

3rd. Great factories evaporating and boiling in vacuum.

The experiment which was made at Clugny has proved that the manufacture may be carried on with the Icery process without the least change in the working.

It appears to me, however, that it would be useful to add a *monte-jus*, in order to avoid the skimming of the juice by hand after the defecation by lime. Some persons think that it would be advisable to add two or three defecators to render the general operations more speedy; I do not see any great necessity for them; but as these defecators could do no harm, they might be added to the plant of the factory without inconvenience.

Thus the needful expenses for the application of the process, which I might call the expenses of installation because they would only be made once, would consist of

1st. Cost of a *monte-jus;*
2nd. ,, of two or three defecators;
3rd. ,, of monosulphite of lime apparatus;

4th. Bounty to be paid to Dr. Icery, which will vary between 5 to 20,000 francs (£200 to £800).

But the annual expenses, those which may be called the productive expenses, would be singularly diminished with this process. Instead of the considerable sums expended in animal charcoal and in its revivification, sums which according to the quantity of the sugar manufactured reach 10, 20, 30, or 50,000 francs, the factory would only have been put to the expense of two coats of paint, a little stronger than are generally given other years to the machinery, of a quantity of gravel, or broken stones, and a supply of lime and of sulphur, needful for the production of the monosulphite of lime which it would use. Some hundreds of francs would thus replace some thousands.

Criticism has, however, been raised against this very economical process. It has been affirmed without any endeavour to prove by arguments founded on fact, that the new process will not succeed in practice. But, fortunately, the contrary has been established in a most satisfactory manner by the experiments made at Clugny and at Mineurs. I have been able to obtain in these factories the sugars which I have shown to you, and by proceeding as in manufacture—and notwithstanding hesitation, very natural to a first trial—I have proved that it is undoubtedly simple and easy, and consequently quite practical. Besides it will be very difficult for the process to lose this character when we know that, in Mauritius, 65 factories have been benefited by it, in obtaining unhoped for results, and that in Reunion the number of those who adopt it increases daily.

But in particularizing the objections it has been further said that the coats of red lead which Dr. Icery desires should cover the wrought iron parts of the sugar machinery, would be worn out in a very short time, and would not long prevent the formation of sulphite of iron. To whom should we apply on this point, to those who speak without experience? or to Dr. Icery, who is at the same time a man of science and a practical man?

Further I can still answer by facts. At Mineurs, to some of the wrought iron boilers, a single coat of red lead paint had been given in haste, and this slight coating had perfectly resisted, during five weeks of manufacture, the strong fire of the apparatus and the friction of the wooden ladles which served to transfer the juice.

The conclusions which may be drawn from the above are, gentlemen, 1st. that the great factories such as those already established, would have very marked advantage in employing the [Icery] process. 2nd. That the results would be more decided still, in the small Bourbon factories, which would be enabled, thanks to this process, to produce the same products as the great factories where the double filtration is practiced; and 3rd. that the ordinary factories, whilst being able sensibly to improve their produce, would be able to reboil their syrups; and that the expense necessary for each of these modes of manufacture would be very nearly covered by the benefits realized the first year.

LIME AND MANURE FOR CANE SOILS IN THE WEST INDIES.

By Dr. T. L. Phipson, F.C.S.,

Corresponding Member of the Chemical Society of Paris, &c.

It appears from a recent article in the *West Indian* that a large export trade in lime has, of late years, grown up at Barbados for Demerara, where it is applied to the fields as manure. The shipment last year, we are told, reached 11,000 hhds., making the chief article of freight on board the schooners trading between the two colonies.

Now, a great portion of this lime having been imported at Demerara upon my recommendation, it becomes my duty to warn the owners of Demerara estates against a species of lime rather extensively used, I believe, in Barbados which is of very bad quality, and unsuitable to the agricultural purpose for which it is employed. It is neither a pure limestone nor a marl, but a detestable kind of dolomite containing a large proportion of manganese, protoxide of iron and magnesia. The manganese in it is so abundant as to show here and there in brown spots upon the surface, and even when these are not visible, the specimens yield an abundant evolution of chlorine gas when dissolved in hydrochloric acid, which is due to the oxide of manganese present. I consider this to be about the worst possible description of lime for agricultural purposes; and it is to be hoped, not only that the Demerara planters are not importing it largely, but that in Barbados its use may be altogether discarded.

Coral rock, shells, marl, chalk, or compact limestone ground, are the proper kinds of lime required in our cane fields; they may either be burnt or unburnt; if not burnt they should be ground fine, and if burnt should be allowed to slake thoroughly, and not be applied to the land in a caustic state (*i.e.*, as quick lime), except where the soil contains an excess of acid organic matter, or approaches to a peaty nature.

Of all limestones I would prefer for the Demerara soils a good marl; it is easily pulverized, contains a notable amount of phosphates and some sulphate, often a little potash also, and requires no slaking. But it is perhaps not always easy to procure such an article. However that may be, it is almost as shortsighted to import bad limestone from Barbados as it would be to ship from England any of those sewage manures which contain from 50 to 70 per cent. of clay, sand and moisture, and to which chemical analysis has only assigned a value of twelve to fourteen shillings per ton.

Much benefit would also result if the lime were applied in three successive forms: for instance, the first season a dressing of chalk or shells (carbonate of lime); the next, a rather smaller supply of gypsum (sulphate of lime); and the third, a liberal supply of crushed bone (phosphate of lime) or bone meal. Now, one of the advantages of the Urban cane manure, which I have more than once alluded to in this journal, is that it supplies lime in these three forms, and as manufactured at Bloxwitch for the Demerara estates, this particular feature in its composition is expressly given to it, so that, whilst supplying the plant with all the other ingredients it requires, it enables the planter to dispense with the costly operation of liming. I am thoroughly convinced that the use of this manure upon the same estate for a period of, say, five seasons, would produce the same results to the planter, as if he had limed his soils and alternated the liming with the best manure imaginable, and, of course, at considerably less expense.

Some of my readers have enquired why I do not recommend acid manures, such as superphosphate, phospho guano, and acidified Peruvian guano, as a source of lime and other ingredients for the Demerara and Barbados soils? It is simply for the reason which I have before given in this journal (and applies to all the West India soils that I have hitherto examined), namely, the rather limited supply of lime in these soils and their tendency to become acid, to which it may be added the presence in many of them of a considerable quantity of protexide of iron.

It is evident that every molecule of what is called biphosphate of lime or acid phosphate of lime, must meet with at least one molecule of lime in the soil, and so become neutralized before it can be touched by the rootlets of any plant. It appears that in some well made superphosphates this change takes place to a certain extent in the manure before it reaches the soil, but it is only partial and it is rare that more than 2 to 4 per cent. of *precipitated*, or "reduced," phosphate as it is sometimes called, is met with in any superphosphate, all the remainder of the phosphate consisting of *acid* biphosphate and a little *ordinary* phosphate of lime. Here again, the Urban cane manure has the advantage, for precipitated phosphate manufactured for this purpose is expressly added to that which is destined for the Demerara soils, forming a *fourth* state in which the lime exists in this manure.

Not only is there not lime enough in many of the Demerara and Barbados cane soils to supply the molecule necessary to neutralize the acid phosphate, but often there is present a considerable amount of protoxide of iron, which is worse still, for in this case a phosphate of protoxide of iron is formed and proves highly injurious to the crops. These soils which contain much protoxide of iron are usually of a dark colour (in Barbados, dark green, when dry, approaching to brown), we meet with them in Barbados and Jamaica oftener than in Demerara, and they burn very red. Some specimens which I have analysed give 8 to 10 per cent. of oxide of iron, whilst 2½ to 4 per cent. is a normal amount in all West India cane soils of ordinary quality. When there is much protoxide of iron the application of lime in some form or other followed by manure, and the greatest amount of aeration possible will, in a little time, remedy the evil, but will often require three or four seasons.

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MODERN VIEWS ON FILTRATION.

By J. V. Divis.

From the
"Zeitschrift fur Zuckerindustrie,"
Prague.

Animal charcoal owes its great importance in the sugar manufacture to two chief properties: the absorption of the lime, and the elimination of the foreign substances of the juice.

Chemists have repeatedly endeavoured to determine the constitution of animal charcoal, and to explain its properties fully. The solution of these different questions is so much more desirable, as it would then be easier to discover a substitute for this useful but costly article.

In the course of time various theories have been set up to explain the phenomena which happen in the filtration of the juice. The chemist Anthon ascribes the absorption of the lime to the carbonic acid which appears to exist in a condensed state in the pores of the animal charcoal, and which transforms the soluble caustic lime into insoluble carbonate of lime. I cannot endorse this opinion. If even the char had absorbed from the air a considerable quantity of gas, the greater part would be thrown off again during the steaming of the filter. The expansion of the gas increases with the temperature and therefore the animal charcoal could not retain carbonic acid in the presence of steam of a high temperature. A further proof of the disengagement of the gas is the disagreeable smell proceeding from the filter whilst being steamed.

During some careful researches on animal charcoal, I arrived at the conviction that it retained the lime absorbed in the state of caustic lime, which, when treated with a solution of sal ammoniac, disengages the ammonia, and if this ammonia could be collected by an acid of precise standard it would be easy to discover the quantity of caustic lime contained in the charcoal. It is on this experience that I base my new method of revivication through sal ammoniac.

It is only through the influence of the air—by the carbonic acid which it contains—that the caustic lime is transformed into carbonate of lime, and it is in this way that the Schatten process of revivication by hydrochloric acid becomes the more reasonable the sooner the char and the acid are brought together after the filtration. The decomposition of the caustic lime is effected without the disengagement of the gas, that of the carbonate of lime with considerable production of gaseous bubbles, which adhere to the char and neutralize the energetic action of the acid. It is here a mistake has very often been committed. For instance, I remarked in a sugar factory the filter head connected with a tube of which the purpose was, after the washing, to conduct a current of carbonic acid into the filter, thus to revivify the animal charcoal by transforming all the lime into corresponding carbonate! I think it is needless to point out the uselessness or the injurious nature of this operation.

In course of time some carbonate of lime is formed in the charcoal notwithstanding the greatest care, but this is far from being as injurious in filtration as an accumulation of organic matter. In the sugar manufacture it is an old and apparently universal prejudice, that animal charcoal should not contain more than 11 per cent. of carbonate of lime; and that this limit should not be passed if you would avoid turbid juice and bad filtration. In truth, this principle is unsound at the bottom, and I will give an instance to disprove it.

Not long after the beginning of the season, a revivified animal charcoal showed a proportion of 15 to 16 per cent. of carbonate of lime; every precaution possible was taken in the factory, notwithstanding which, the proportion reached 17 to 18 per cent. and in some instances 19 per cent. We should naturally have considered these figures as proofs of defective filtration of the juice, but contrary to expectation, the juice was of a limpid purity:—in fact, the boiling in vacuum was effected with remarkable facility. The unexpected increase of the lime was explained later on by the appropriation of mineral waters, to the washing away of the adherent lime. These waters contained, besides free ammonia, carbonate of ammonia, through which the carbonate of lime was formed. This fact on one hand and the alkaline reaction of the charcoal which follows the application of ammonia water on the other, is prejudicial to the hydrochloric acid treatment.

After this, the new theory of M. Wernckink will appear much more strange—since, according to him, it is the condensed carbonic acid which is the cause of the absorption of the lime—yet it is with the aid of other gases such as oxygen and nitrogen, that he seeks to explain the other actions of animal charcoal. That the one retains in a state of condensation a quantity of gas, is true, but physics shows us though the expansion of gases is decreased by low temperatures, it is increased by heat.

Thus, according to Thilorier, the vapour from liquid carbonic acid exercises at 20° C. (4° below zero Faht.) a pressure of 20 atmospheres, at 0° C. (32° Faht.) a pressure of 36 atmospheres, and at 30° C. (86° Faht.) a pressure of 73 atmospheres, that is to say, to maintain carbonic acid in a liquid state at 30° C. (86° Faht.) it must be submitted to a pressure of 73 atmospheres. Thus after what has been said, it is very doubtful whether the absorbent power of animal charcoal for carbonic acid can be so enormous.

The results of the experiments of Sausure showed that boxwood charcoal, the pores of which are very fine, absorbed scarcely 35 times its volume of carbonic acid and 9 times its volume of oxygen; in the pneumatic vacuum or even under the action of heat it gave up nearly the whole. A temperature of 30° Cent. (86° Faht.) is very common in the sugar factories, and besides that there is heated steam which is blown into the charcoal; it is then impossible to suppose the presence of liquid carbonic acid in the pores of the animal charcoal.

The decoloration of the juice is explained by M. Wernekink in a manner more interesting than scientific—he says that the absorption of colouring matter by animal charcoal is a phenomenon identical with the bleaching of linen. The condensed oxygen in the pores has a very great oxidizing power, something similar to that of ozone; it oxidizes and bleaches the colouring principle. But bleaching is not exactly the same as purifying, sulphuric acid will bleach as well as decolour the juice, but for all that, it does not eliminate the organic matters; the purification is only apparent, for the juice thus decolored will become turbid and colored again during the process of boiling.

Ozone acts in this way. It oxidizes equally the colouring substances and modifies them by long contact. But it does not separate them from their solution. It is besides easy to show that the decoloration of juice by animal charcoal is a phenomenon essentially different from bleaching.

All tends to prove that in the decoloration, the colouring substances are not destroyed, but are absorbed by the char. An example is ready to hand: M. Wernekink cites the action of animal charcoal on a solution of indigo. In filtering a solution of indigo, a colourless liquid is doubtless obtained, but it is sufficient to wash the char with weak alkaline water to recover the blue matter unmodified. Thus empyreumatic oil may be extracted from weak alcohol by animal charcoal, but it may easily be recovered again by strong alcohol. It is thus, again, that powdered charcoal absorbs an alkaloid which it has filtered from an aqueous solution, but gives it up again when treated by alcohol.

The decoloring power does not belong exclusively to charcoal; some other substances, organic and inorganic, possess this property, for example, certain tissues, animal and vegetable, alumina, hydrated oxide of iron, sulphate of lime, sulphate of lead precipitated, &c.

How then can the various actions of animal charcoal be explained? Do they proceed from chemical or physical forces?

The absorption by animal charcoal is effected in consequence of the attraction of molecular surfaces, the porosity, and the capillary conditions resulting from it, allow the contact of liquids with a very extensive surface of a solid body. If we now consider that the capillary force of water in a tube of a millimetre in diameter is equal to the pressure of a column of water of 30 millimetres; in a tube of $\frac{1}{10}$ of a millimetre to the pressure of a column of water of 300 millimetres, and in a tube of $\frac{1}{10}$ of a millimeter to the pressure equal to a column of water of 1000 millimetres, we can hardly conceive the force with which a liquid penetrates into a porous body.

It is more difficult to explain why the same porous body absorbs a greater or less quantity of different liquids.

Thus, Mr. Graham found that 100 parts of dry animal membrane absorbed in 24 hours:

Pure water	268 parts.
Solution of common salt	133 ,,
Alcohol at 84°	38 ,,
Animal empyreumatic oil	17 ,,

We see in the same way that char appears to have a special predilection for the absorption of certain substances, and it is especially in the filtration of saccharine solutions that it shows this preference.

This difference of absorbing power is due to the difference of attraction which the char exercises on certain bodies. If we allow a membrane which has been soaked in oil to remain for a while in water, we shall see that the oil will, little by little, be removed from the membrane, and at last that it will be entirely replaced by water. (Graham.)

This fact appears to bear very closely on endosmose, which is also explained by capillarity, by reason of which a liquid will penetrate into internal pores. It is then quite possible that many of the phenomena of filtration may be related to those of endosmose; we may now compare this theory with the facts.

We will make a division of two classes:—

1st. Crystalloid bodies, *i.e.*, substances crystallized or crystalline.

2nd. Colloid bodies which comprehend all amorphous substances, of which starch may be taken as a type.

The first penetrate easily the walls of the pores, the second with difficulty, or not at all. The filtration of the juice may be considered as a separation of the crystalloid from the colloid substances, of crystallizable sugar from the amorphous, albuminous, elemen's, the pectic and nitrogenous substances, the colouring matters, the fatty matters, the caramel, the lime, &c. The animal charcoal forcibly seizes on these colloid substances, whilst it does not exercise any action on the sugar or alkaline salts. The force of absorption depends on the solubility of the substance The char absorbs all the constituent principles of the juice; but whilst it retains the least soluble it allows the others to pass. Making rather a hazardous comparison we might say: the diffusion of the slices [of beet] is a method of filtration. In both cases we wish to separate the colloid from the crystalloid substances by means of diaphragms—in one case by means of cellular walls, in the other by means of the porous charcoal.

But in the midst of all the physical phenomena chemical action intervenes.

Animal charcoal like carbonic acid decomposes the saccharates of lime and retains the lime. The same action it also shows on saccharates of baryta, and of strontian.

Thus the celebrated Graham was able to decompose sulphate of ammonia; sulphate of potash and of soda may likewise be decomposed in this manner when subjected to a kind of diffusion in a solution of lime.

It is difficult to discover what principle it is in the char which produces these chemical reactions; it is even possible that it is still the physical power of capillarity and of endosmose which come into play.

There is no reason then to invoke the condensed gases or ozone to explain the decolorizing power of animal charcoal; we may daily observe at the dyers', phenomena analogous to those we have been considering. Colouring substances, properly so called, combine directly with the tissues. If some well washed cotton is soaked in an aqueous or alcoholic solution of these substances the colouring matter is immediately absorbed into it and it will be vain to endeavour to remove it with water. This property of cotton is possessed by both animal and vegetable charcoal, as well as many substances, such as alumina, &c.

I have endeavoured in the above to confine the properties of animal charcoal employed as a filtering body to some actions purely physical, and I may conclude by laying down the following principles respecting the revivification of animal charcoal:—

The lime eliminated from the juice by absorption is found as such in the char and is only transformed into carbonate of lime under the influence of the air.

The lime should be separated from the char as quickly as possible after filtration to avoid the inconvenience in question.

The absorption of the principal colorants from the juice is not in consequence of a condensation of gas,—it would be necessary if this were so to abandon the steaming of the filters, a process specially recognised as very important by the greater part of those who practice it,—it is rather an effect of the porosity and extreme subdivision of the animal charcoal. It is then especially needful to keep the pores of the char open, and all processes of revivification should be rejected where the skeleton of the char (if I may thus express myself,) would be found to be disorganized, and which would tend to transform it into inert powder.

We will conclude with an extract from what the eminent Dr. Weiler has said on the subject of the revivification of animal charcoal:

"It is astonishing," says he, "that chemistry, which has so largely contributed to the development of the sugar industry in all its phases, has neglected one of its most important auxiliaries, animal charcoal. We find ourselves to-day in the same state of ignorance of it as thirty years ago, and we should hail with enthusiasm any new process which would raise the veil of obscurity which covers the question of the revivification—I should say of the mortification—of animal charcoal."

THE SUGAR QUESTION.

This question is at length to some degree settled; the English Government having consented to call a Conference of the four contracting powers, for the modification of the provisions of the Convention of 1864.

A Report, dated May 18th, has been issued by the Committee of the Sugar Refiners of Great Britain, of which the following paragraphs form the conclusion :—

After referring to the congress at Brussels, it continues: "At the same time the preparation of another memorial, going into all the details of the question, was commenced. It was completed in three weeks, signed by the whole trade of the United Kingdom, with only two exceptions, and presented to Mr. Gladstone on the 8th of May, under cover of a note signed by about thirty Members of Parliament, representing all the boroughs interested in the sugar refining trade. Memorials were also addressed to the Treasury about the same time by large sections of the West Indian trade, by sugar brokers, by the wholesale grocers in the large centres of production, and by the grocers of some large provincial towns. On the 27th of April, owing to a communication received from the Custom House, meetings of the trade were called in London, Liverpool, Greenock, and Bristol, at which full power was given to the Committee to act according to circumstances on the important subject of the expense which might be incurred by the revenue in adopting a system of refining in bond. The Committee, finding that no other proposition would be acceptable to the Government, gave an undertaking that the trade would bear whatever extra expense in the collection of the revenue such a system might involve."

"The Committee are now happy to be able to state that their unremitting efforts, which have extended over more than three months, have at last been successful, and that on the 7th of May they received the following communication from the Treasury :—

"Treasury Chambers,
"6th May, 1872.

"Sir,

"With reference to the Memorial signed by you and other sugar refiners "of London, Greenock, Liverpool, Bristol, Plymouth, and Manchester, I am "directed by the Lords Commissioners of Her Majesty's Treasury to state "that my Lords, after a further careful consideration of the representations "addressed to them as to the imperfect operation of the Convention of 1864, "have felt it their duty to request the Secretary of State for Foreign Affairs "to invite the Governments of France, Belgium, and Holland to a Con-"ference, in order to consider what modifications may properly be introduced "into the provisions of the Convention.

"My Lords think it right to notify to you, for the information of the "Memorialists, that in the event of a joint recommendation being made by "the members of the Conference in favour of an International system of "refining in bond, their Lordships will only be prepared to entertain such a "recommendation, as regards this country, upon the distinct understanding "that all expenses incidental to the bonding arrangements which may be "established shall be borne by the persons availing themselves of those "arrangements.

"I am to add that my Lords have received and noted the paper signed by "yourself and Messrs. Duncan, Barrow, Easton, Blair, Neill, and Finzel, "undertaking on behalf of the trade of the United Kingdom to bear the "expense of supervision of refineries under bond, and to accept any system "of levying it which the Government may deem it right to propose.

"I am, Sir,
"Your obedient Servant,
"R. R. W. LINGEN.

"A. W. Gadesden, Esq."

"The Committee cannot conclude this Report without congratulating the trade on the great unanimity which has prevailed during these long and difficult negociations. They hope that the confidence which was reposed in them at the time when they were nominated will be continued, and that when their present labours are at an end they may remain as a Standing Committee, capable of receiving instructions from their various centres, and of settling many questions connected with the trade which have long wanted attention, and of dealing with others as they may arise. Such a Committee appears to be a most desirable institution in a trade which has become so large and so widely scattered, and the recent experience of the cordial co-operation which has been met with on all hands leads to a hope that such co-operation may be continued with great benefit to the trade at large.

(Signed) A. W. Gadesden, *Chairman*.
James Duncan.
George Martineau.
Robert Blair.
John Neill, Jun.
James Barrow.
Thos. O. Easton.
Conrad W. Finzel.
Matthew Hy. Hale.
Joseph B. Forster.

Dated May 18, 1872.

It must not be taken for granted that because the provisions of the Convention are to be reconsidered that refining in bond and duties payable on sugar going into consumption are therefore certain to be adopted, though it will be difficult to devise any other means of equitably settling the question.

The *Produce Markets' Review* has returned to the advocacy of a single duty and a single drawback on sugar; and has drawn a vivid picture of the difficulties of refining in bond. As to the former, a uniform duty and drawback seem less likely to find favour than ever; either in this country or on the continent; and as regards the difficulties of refining in bond, we feel sure that they have been over estimated and that the danger of fraud on the revenue is exaggerated. It is quite impossible that the refiners of Great Britain should have so earnestly advocated the adoption of refining in bond without "first counting the cost," and whatever the difficulties may be, there is no doubt that if the system passes into law they will be overcome.

It is much to be regretted that Government has made it a *sine qua non*, that the whole of the expenses of the supervision of refineries shall be borne by refiners themselves, especially as such a provision is scarcely likely to be imposed by the other contracting powers on their refiners.

In conclusion, it must be acknowledged that the many branches of the British sugar trade, whose interests are identical, are deeply indebted to the Committee of the British Sugar Refiners for their energy and perseverance, by which they have triumphed over obstacles which at one time appeared unsurmountable.

GUADELOUPE AND

Sugar and Molasses exported since the 15th July, 1816

	Raw Sugar.	Clayed.	Total.	Average Price per cwt. of good 4ths.		Molasses.	Observations.
	Tons.	Tons.	Tons.	s.	d.	Tons.	
1816	3,477	1,827	5,304	....		2245	
1817	14,118	3,776	17,894	....		5302	
1818	18,779	2,346	21,125	....		4700	
1819	15,771	2,965	18,736	....		4396	
1820	19,759	2,539	22,299	....		6691	
1821	21,743	1,275	23,019	....		5991	
1822	21,907	1,569	23,477	....		8825	
1823	23,297	1,026	24,323	....		7660	
1824	30,396	248	30,644	....		8182	
1825	23,839	175	24,014	....		5885	
1826	34,170	159	34,330	....		6821	
1827	28,143	122	28,265	....		4455	
1828	35,739	70	35,810	24	7	5186	
1829	33,700	111	33,811	24	11	3111	
1830	32,823	74	32,898	22	6	2594	
1831	34,981	75	35,056	16	3	5140	
1832	33,254	24	33,279	....		4094	
1833	30,821	5	30,827	21	2	4023	
1834	37,921	6	37,928	....		4024	
1835	32,092	4	32,096	....		2913	
1836	34,991	3	34,994	22	4	3265	
1837	25,055	1	25,057	21	0	1717	
1838	35,119	4	35,123	16	2	3348	
1839	36,448	223	36,671	16	0	4682	
1840	29,871	72	29,944	....		1474	
1841	29,130	5	29,135	19	10	1024	
1842	35,370	1	35,371	17	4	736	
1813	27,168	1	27,169	17	4	1041	
1844	34,553	1	34,554	....		1687	

ITS DEPENDENCIES.

the period when possession was restored to France.

	Raw Sugar.	Clayed.	Total.	Average Price per cwt. of good 4ths. s.	d.	Molasses	Observations.
	Tons.	Tons.	Tons.	s.	d.	Tons.	
1845	33,747	1	33,747	20	7	1481	
1846	26,372	....	26,372	20	2	264	
1847	37,894	....	37,894	19	11	276	
1848	20,453	....	20,453	....		29	
1849	17,708	....	17,709	....		9	
1850	12,831	....	12,831	....		1	
1851	20,046	....	20,046	....		16	
1852	17,291	....	17,291	22	0	6	The price of good 4ths was only taken on the average of part of the year.
1853	16,679	....	16,679	19	8	1	
1854	23,558	....	23,558	19	1	....	
1855	22,157	....	22,157	20	1	1	
1856	22,505	....	22,505	26	8	....	
1857	22,462	....	22,462	30	1	4	
1858	28,294	....	28,294	22	1	4	
1859	37,666	....	27,666	24	8	33	
1860	28,800	....	28,800	22	3	65	
1861	27,316	....	27,316	21	4	74	
1862	31,312	....	31,312	18	4	112	
1863	30,265	Refined.	30,265	18	3	352	
1864	15,784	121	15,905	24	8	207	
1865	24,447	9	24,456	18	3	205	
1866	33,941	Usine.	33,941	17	9	628	
1867	10,578	12,181	22,759	18	8	289	
1868	13,029	17,762	30,792	18	4	315	About 15 tons of sucrate of lime included in raw.
1869	12,045	16,554	28,600	19	8	308	127 tons concrete included in raw.
1870	12,301	21,915	34,216	18	2	534	279 tons concrete.
1871	12,684	25,749	38,433	20	1	260	364 tons concrete included in the raw. 3500 hhds. of sugar burnt 18 July, not included.

THE COOLY QUESTION IN JAMAICA.

It appears that many of the planters of Jamaica feel aggrieved with the present laws respecting Coolies in that island, especially with those which throw the cost of Cooly immigration entirely on the planters availing themselves of Cooly labour.

An esteemed correspondent has forwarded a copy of "Resolutions passed at Meetings of certain Planters of this island [Jamaica] to Petition the Government in favour of a revision of the laws relating to Cooly and other immigrants."

The following resolutions were passed at a Meeting held several months ago, at Montego Bay:—

"That the gradual withdrawal of labour renders sugar cultivation in this country very precarious, retards the advance of capital, and makes the employment of imported labour more and more necessary year by year, to uphold present cultivation."

"That the cost of production for this reason has been greatly increased, at the time when competition with beet-root threatens serious results to the interests of Jamaica."

"That the creation of wealth by the intervention of Cooly labour on estates is of considerable advantage to all classes of the community. They who prefer to grow provisions and other minor products, and rear small stock (the number of whom are increasing) depend largely upon the traffic induced at the markets, where the wages of the Coolies, after a short residence, are more or less distributed, and derive profits thereby, which are in turn expended in purchases of commodities from merchants and shopkeepers, whereby the interests of the latter are subserved and the revenue of the island *pro tanto* increased."

"That the Coolies are themselves considerable contributors to the general revenue."

"That without this creation of wealth these advantages would not accrue to the interests specified. The contrast presented in those districts where the cultivation of sugar is continued on a large scale, principally by means of Cooly labour, with those in which abandonment has wholly taken place, or a restricted cultivation yet exists, attests the fidelity of these statements."

"That it is objectionable, even unjust, that while these advantages result from the employment of Cooly labour, the entire cost of their introduction and return, and expenditure incurred on their account in the island (which have largely increased of late) should be thrown entirely upon the sugar planters, while very many of the Coolies remain as settlers, and funds hitherto appropriated in aid of this object have been either given up or diverted to the general purposes of the island."

"That this meeting submits the foregoing resolutions to his excellency the Governor, having full confidence in his impartiality, and the ability evinced by him in the administration of public affairs.

These resolutions were signed by G. M. Lawson, Chairman; and by a considerable number of the planters and proprietors of that part of the island.

Another meeting held at Annato Bay approved the above resolutions, and a third meeting not only endorsed the action taken at and by the meeting at Montego Bay, but passed several additional resolutions, addressed to the Colonial Secretary of Jamaica—these resolutions were also signed by a number of the planters and estate proprietors of Clarendon.

"That the supply of native labour on the estates in this parish has been for many years past most uncertain, and of late scarcely obtainable at any price, making it impossible to keep in order the present area of cane cultivation, whilst pasture lands for cattle have been growing into ruinate."

"That from this capricious and utterly inadequate supply of labour, the cost of cultivating and producing our chief staple has been largely increased; thereby threatening the planter with serious loss in the competition with the grower of beet. That the withdrawal of the native labourers from estates employment has been caused by their becoming cultivators of the minor products, and by devoting their time to the rearing of small stock."

"That the revenue of the island must suffer materially from the precarious condition or final abandonment of sugar estates in the lessened amount of taxes and reduced circulation of money which must result therefrom. It is therefore the paramount duty of Government to sustain, by every means in its power, the production of the chief staple of the island."

"That this can only be effected by a large annual immigration of Cooly, or other suitable labour, which would produce results beneficial to the general public, as well as to the planters, by the increased consumption of dutiable goods and a largely increased circulation of money in the various markets and stores."

"That as all classes of this island derive manifest advantages from the immigration into it of East Indian or other labourers, and that the planters can claim the services of such labourers for only five of their ten years' residence in the island, whilst many of them remain as settlers, thus adding to the stability of the colony, this meeting considers it most inequitable that the whole cost of the introduction, medical care for five years, and return passage of such immigrants should be levied upon the planter."

THE SUGAR MARKET.

The decidedly improved condition of trade, and the consequent more general distribution of comfort during the past eighteen months, have had an influence which never fails to be witnessed in the consumption of sugar. There are indeed few more unerring tests of the prosperous or unprosperous condition of affairs than this supplies, and it is therefore a satisfactory circumstance that within the period spoken of, the requirements of the public have caused an increase which may be fairly taken at no less than one thousand tons per week—the figures in 1869-70 being 12,000 tons against 13,000 at present. With an increasing consumption, it is not surprising to find an advance in quotations averaging from about 2s. 6d. to 3s. has been generally established over last year; but it is to be regretted the promise of supply is not in better keeping with the demand. The following figures, which are the result of an earnest desire to arrive at data to be depended on, speak, however, for themselves, though it must be remembered they are but conjectural, saving for the stock, which may be taken as a sufficiently close approximation. They refer to the United Kingdom.

		Tons.
Our stock may be taken as		82,000
And our import last year from 1st May to 31st July was		224,000
But this year it is feared, with good reason, our import will be deficient in beet and West India as much as	90,000	
Other sources, however, may supply an excess of	25,000	
		65,000
Leaving our probable import to 31st July this year from date		159,000
Thus giving us a supply to August of		241,000
Now, an estimated consumption of 13,000 tons per week in the same interval of 13 weeks is		169,000
And consequently our stock on the 31st July would be only		72,000

This is a very dangerous figure, particularly when the heavy consumption and compartively light supplies witnessed in the later months of the year are remembered. It might be assumed that the present consumption would be further stimulated by the reduction in the coffee duties, and by the general advance in wages witnessed on all sides at this very moment. But, in fact, our prospects of supply will not bear an increased consumptive demand, as is pretty apparent if our figures are not utterly erroneous, and they are certainly well based, if not proved by time to be sufficiently accurate.

What, then, is a logical deduction from the premises established? Simply that a dearer market may be reasonably looked for in sugar, unless we are destined to a revulsion in trade, which shall do away with our present prosperous condition; and at present everything seems *couleur de rose*, if we set aside the momentary fear of a dearer money market and the results which generally follow it. It is, however, known to those most interested in sugar that no great article of commerce is more independent of that dire enemy to most others—a dear money market—so that it is scarcely worth while to speculate on the course the old lady of Threadneedle Street may or may not take, so far as sugar is concerned. With reference to our anticipated supplies, the following extract from the circular of Messrs. Zaldo & Co., dated Havana, 20th April, may not be without interest:—

"Favoured by the dry weather of late, several estates in the jurisdiction of Matanzas, Cardenas, and Cienfuegos, have already finished, and others, we understand, are about to finish grinding, and most of them, strange to say, with a considerable deficiency as compared with their last year's crop, in consequence of the poor yield, and in some instances, the poor growth of the cane. This result has taken us by surprise, being contrary to general expectation and opinion hitherto, and notwithstanding that many estates will show an increase in the yield, the latest accounts from some of the most important districts are such that fears are now entertained that unless the most favourable circumstances attend the balance of the grinding season, the total crop will be little if at all larger than last year's; whereas, should the rainy season set in earlier than usual, a serious deficiency might ensue, and the crop of 1872 eventually prove to be the smallest produced by the island for several years past. By the middle of next month we shall be, no doubt, able to come to a more definite conclusion on this interesting and important point."—*Liverpool Daily Courier.*

BARBADOES.

May 10th, 1872.

There are signs of a break up of the long spell of dry weather since February. We have had showers in the last two or three days with changeable weather. The old crop is pretty well through on the black soils, and about half way on the Cliff. The shipments to date amount to 11,645 hhds., 1,006 tcs., 6,421 brls., 1,524 bags sugar, equal to 13,300 hhds. Up to the same time last year the shipments amounted to 20,479 hhds. sugar; in molasses, 6,091 puns., 262 hhds., 381 brls., against 7,921 puns., 467 brls., and 384 brls. last year; showing a falling off of about one-third of the quantity to date this year. The price is better for sugar, from 4·50 dols. to 4·80 dols.; and for molasses, 18 cents. per gallon, and cask, 4 dols.

The young canes have not suffered materially from the dry weather, and the showers are all in their favour. Their appearance generally is very promising. The inadequate rainfall of last year has caused the ponds to give out earlier than usual, and as an indication of the severity of the weather, in a district abounding in springs, we are informed at *Sedgepond*, (St. Andrew,) the large pond under the Cliff, between that estate and *Four Hills*, which has never been known to go dry before, has been cleaned out, affording employment to the labourers at a time when there was little else for them to do, after the close of the crop. This neighbourhood as far as Boscobelle appears to have suffered more than any other from the failure of the rain last year. The watercourses are dry, and the cattle find grass where they are accustomed to look for water. The Church river district through *Walkers, Belle Plain, and Bawdens,* has suffered more than the *Upper Valley* through *Bruce Vale*, *Baxters*, *Cane Garden*, *Poole*, *and Grove*, where the crops will be nearly as good as last year. For instance, at *Cane Garden*, 78 hhds. from a small estate of 120 acres, whilst *Walkers*, one of the largest estates in the island, from upwards of 100 acres of plant canes, has not reaped more than 50 hhds., averaging half a hhd. to the acre, and *Belle Plain* not so much. On the whole, from what we have heard, the estates in St. George's, St. Thomas, and St. Joseph, will do better than any others, making nearly average crops, and in some favoured localities rather above the average.—*West Indian.*

THE RAW SUGAR STOCKS

In the United Kingdom and the United States, on the 1st of November next.

We have been favoured with a hypothetical calculation of the deficiency in the stocks of sugar, in this country and in the United States, on the 1st of November next. No allowance being made for supplies being received from unexpected quarters, or from the decrease in consumption in consequence of advanced prices.

		Tons.
Stocks in United Kingdom, 30th April, 1872, deficiency		28,000
,, Continent of Europe,* exclusive of France		20,000
		48,000
,, United States, 4 ports, excess	10,000	
In South and West, deficient	4,000	
		6,000
		42,000
,, Afloat from East to U. K. and U. S., excess..		6,000
Deficiency............		36,000
West India Crop with Porto Rico and French islands, less		70,000
Probable decrease in importation of French Beet, between between April 30 and Nov. 1, as compared with last year		40,000
		146,000
Probable increase in consumption in U. K. and U. S....		40,000
Apparent deficiency on 1st November next, in stocks, as compared with 1871		186,000

assuming that Cuba will ship the same quantity as in 1871.—Whilst the stocks of sugar, in the U. K. and U. S.,

were on the 1st of November, 1869....	233,000
,, ,, 1870..................	233,000
,, ,, 1861..................	216,000

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* The stocks in Europe can only be estimated.

HAVANNA AND MATANZAS.

Exports from the 1st of January to the 5th of April,

(From Licht's Monthly Circular.)

	1872. Tons.	1871. Tons.	1870. Tons.
To United States of N. America	64,933	49,029	61,371
,, Great Britain	18,966	21,716	44,488
,, Northern Europe	2,705	1,365	3,234
,, France	2,677	2,695	9,382
,, Spain	8,262	11,158	20,974
,, Southern Europe	....	25	572
,, Other Countries	2,175	843	1,882
Total	99,718	86,831	141,903
Stocks in Havanna and Matanzas	72,530	73,996	118,251

MAURITIUS.

Exports from 1st August to 2nd April.

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
To England	38,444	16,014	34,698
,, France	13,885	5,930	11,155
,, Australia	22,308	31,440	35,094
,, Bombay	23,187	14,475	28,496
,, New Zealand	2,833	2,962	3,696
,, Cape of Good Hope	860	1,759	1,363
,, Other Ports	5,353	612	1,109
Total	106,870	73,192	115,611

Estimated Production of the present Beet-root Crop of Sugar compared with the two previous seasons.

(From Licht's Monthly Circular.)

	1871-72.	1870-71.	1869-70.
	Tons.	Tons.	Tons.
France	325,000	289,083	289,324
Germany (Zollverein)	182,500	262,986	217,192
Austro-Hungary	162,500	182,280	151,354
Russia and Poland	90,000	135,000	132,500
Belgium	75,000	55,739	43,552
Holland and other countries	25,000	17,500	12,500
Total	860,000	942,588	846,422

Stocks of Sugar in the Chief Markets of the World on the 1st April, in thousands of tons, to the nearest thousand.

	1872.	1871.	1870.
Great Britain	92	97	106
France	71	128	110
Germany (Zollverein)	20	46	29
Holland	43	27	30
Six other Ports	5	5	4
Total in Europe	232	303	280
United States of N. America	46	48	95
Havana and Matanzas	73	74	118
Total	351	425	493

Consumption of Sugar in Europe and the United States, for the Years ending 31st March, in thousands of tons.

	1872.	1871.	1870.
Great Britain	689	731	620
France	303	324	313
Germany (Zollverein)	216	224	212
Holland	22	29	32
The six other chief Countries	112	92	112
Total in Europe	1,342	1,390	1,289
United States	540	495	413
Total	1,882	1,886	1,702

SUGAR STATISTICS—GREAT BRITAIN.

To 18th May, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	7	2	1	9	18	22	18	3	4	15	40	52	23	2	4	16	46	56
British East India	3	1	..	..	4	9	5	2	..	..	7	3	5	5	..	..	9	11
Mauritius	3	..	1	1	4	4	8	2	9	6	25	9	8	3	10	7	27	8
Cuba	1	1	1	3	6	16	..	2	6	7	15	20	3	1	6	9	19	17
Porto Rico, &c. ..	..	2	..	..	3	6	..	4	..	..	4	7	1	4	..	..	5	8
Manilla & Java ..	11	7	..	1	19	38	12	8	2	7	28	24	13	10	2	8	32	27
Brazil	1	10	1	5	17	14	3	20	5	10	37	27	2	18	4	10	34	27
Beetroot, &c.	5	..	1	2	8	12	11	7	4	30	52	66	11	9	5	33	58	69
Total, 1872 ..	31	23	4	20	79	122	56	49	29	75	209	208	65	52	30	83	230	221
Total, 1871 ..	61	32	6	22	43 decrease		68	45	21	74	1 increase		76	45	21	80	9 increase	

STATE AND PROSPECTS OF THE SUGAR MARKET.

During the last month the market has continued firm and has been occasionally active, although the very small supplies of sugar offering in the various ports tend to restrict trade. There is but little difference in prices, but it is entirely in favour of the seller. No. 12 Havana afloat is selling at 31s. per cwt.; about the same value as at this date a year ago. Cuba Muscovados are worth 28s. 9d. to 29s. 3d. In good Bahias and Pernambucos there is an advance of 6d. per cwt. over last month's prices. The average duty paid price of refining qualities of British Plantation sugar is now 33s. per cwt. Concrete of fair quality was sold last week in London at 30s. duty paid. Pieces and crushed are in good demand, at slightly advanced prices. Common refined lump is quoted at 42s. to 42s. 6d.; the same as a month ago.

Imports have decreased during the month to the extent of 11,000 tons, and to the present time as compared with last year now show a difference of only 1000 tons. Deliveries have increased during the month about 10,000 tons, and about the same extent during the first five months of the year as compared with 1871. Stocks have decreased considerably, and are now 43,000 tons below those of last year at this date.

Prospects do not show a different aspect; it is pretty certain that there is no overplus of production of beet sugar either in France or Germany to warrant the expectation of supplies being received from those countries; on the contrary, several cargoes of cane sugar intended for this country have, on arrival in the Channel, been ordered to French and German ports. It is well known that supplies from the West Indies, including the French islands, are sure to be very deficient. Several accounts from Cuba estimate the present crop as likely to be about the same as that of last year; but as the crop is late estimates are scarcely reliable.

THE
SUGAR CANE.

No. 36. JULY 1, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

For Table of Contents, see opposite the last page of each Number.

ON THE MANUFACTURE AND REFINING OF SUGAR.

[*The Cantor Lectures, delivered before the Society of Arts.*]

By C. Haughton Gill.

(Concluded from page 300.*)*

Lecture VI.

We had a quantity of crystals of sugar floating in a very hot saturated solution. The mass becomes cold, and what happens? The hot saturated solution deposits some of the body, which it held in virtue of its heat, and this sugar deposited from the hot solution forms round the crystals and sticks them all together. It cements this quantity of crystals, and binds them into a firm mass. This loaf of sugar has been treated in this way. It was then sent up to the working floors; a pricker was put in to clear the opening, and the mass was allowed to drain for about two days. In the course of that time a considerable quantity of syrup has drained away from it, but, as you will notice, the sugar is by no means white. It consists of a porous mass of sugar crystals, penetrated all through by syrup. When it has drained away, it leaves an apparently dry mass of sugar, but still soft and crumbling, although sufficiently hard to bear handling. This is not pure sugar yet, there are still crystals of sugar wetted with the syrup; although it is true this syrup is purer than that surrounding the crystals of raw sugar, still it is not a solution of pure sugar. Here is a specimen of the syrup that has drained away, though it may not be a fair specimen of that syrup from this mould, as it may have come from sugar of lower quality. Still the syrup is somewhat dark coloured, and the darkness of the colour arises from the fact that when this apparently slightly coloured liquid which I showed you before, is concentrated, a good deal of the water is removed, and a large portion of the sugar forms itself into essentially white crystals, so that all the remaining colouring matter (together with all the other impurities) has become accumulated in this portion which subsequently drained away. The syrup having drained away as much as possible, the loaf consists of sugar crystals wet with a solution of sugar *plus* the impurities which had not been removed by the previous processes. The refiner has then next to remove from this so-called "green loaf" the adhering syrup which contains the impurities; and the way he does it is to replace this impure syrup by a pure one. That is effected in this way. The loaf is kept in the mould, and on the surface a saturated solution of perfectly pure sugar—at least as perfectly pure as can be obtained on a large scale—is poured. Here is a specimen of a solution such as is actually employed in the refinery for that purpose. As this solution is already saturated before being poured on the face of the mould, there is no fear of the water present dissolving any of the sugar of the loaf. It gradually percolates down, and as it goes it displaces the green syrup still adhering to these crystals of sugar. It gradually pushes that out before it, and this clear liquid, the "fine liquor" as it is technically termed, is kept running on the face of the mould until the loaf is thoroughly purged from the original green syrup with which the mass was wetted. When the workmen know that is the case, they remove the rough surface from the face of the sugar by a fitting tool, and then it is in this state, and the loaf is perfectly white, but still wet. The loaf I showed you before was wet with the coloured syrup, that has now been replaced by the clear one, but it is still wet, and all that has to be done is to finish draining it, and then to dry it thoroughly. This drying is accomplished by putting these loaves into large chambers, heated by steam, which are technically termed stoves. Although they are always heated by steam, they are, nevertheless, called stoves, so that whenever a fire happens in a sugar-house it is always said to commence in a stove. In these large chambers, heated by steam pipes, the loaves are kept for four or five days, until they are thoroughly dry, when they are fit for the market. There is a loaf on the table, but it has not been in the stove, the wrong specimen having been sent by mistake; it has only been drained, but not dried. If it had been four or five days in the stove it would have been harder, but of course of the same quality. Of 100 lbs. weight of this sugar 99¾ lbs. would consist of absolutely pure sugar; indeed, I may say there is no loaf sugar which you buy which has not over 99½ per cent. of true sugar in it, so that you need not fear there is any great difference in the sweetening qualities of the various specimens of sugar, whether it be obtained from cane or beet root.

I have now sketched an outline of the processes used in working up cane or beet root sugar into the white loaf you see before you, but I dare say the question occurs to you, what becomes of all the syrup that has drained away. The syrup that drains away from the loaf in the first case is, as I showed you just now, somewhat lightly coloured, and contains some impurities. That is returned to the vacuum pan, and again concentrated until a certain amount of grain has been obtained in the pan, it is allowed to stand for a few hours, and then passed into the centrifugal machine, to separate the grains from the syrup in which they float. This syrup is of course more impure than that used to clear the loaf, and consequently is much more sticky and darker in colour, and altogether less valuable for obtaining crystals from. However, a considerable quantity of sugar is actually obtained, but it has small and confused grains. I have here some such sugar as it comes from the centrifugal machine, and this we may take as the first product which is obtained from this syrup which has drained from the loaves. This consists of very small crystals, but if they are very small, for the same weight there must be a vastly increased surface, and as there is a greater surface, there is more room for the syrup to stick to, and, consequently, they will actually retain more syrup about them than crystals of a better quality, and not only so, but the syrup itself is more impure. Accordingly, this sugar is somewhat inferior in true sweetening power to what I showed you just now. This soft yellow sugar contains a certain amount of impurities adhering to the crystals, but still contains 87 to 93 per cent. of pure sugar, and 3 to 7 per cent. of altered sugar possessed of sweetening powers, the remainder consisting of 3 to 5 per cent. of water, and a small quantity of salts and colouring matter. It is quite clean and wholesome, and only differs from raw sugar in having a better colour, and in being free from insoluble impurities. In sweetening power it is only inferior to loaf, *i. e.*, pure sugar, as 9 or 9½ is less than 10.

From this first soft yellow sugar a syrup has been drained away which is still darker in colour than that which I have just referred to. This, in its turn, is concentrated, but, of course, it is a highly impure solution, and contains a great quantity of sticky bodies and salts of various kinds—common salt and gummy bodies of different kinds. Still, however, it contains sugar; therefore it is concentrated, and the liquid, which contains generally a very small proportion of grain in the pan, is allowed to stand in tanks for several days. At the end of that time, the syrup, or jelly as it is called, is filled with a number of grains of sugar. These are separated by a centrifugal machine, and there is then a second quality of brown sugar produced in this way. Here, again, you have still smaller crystals as a rule, and they are surrounded with an excessively impure syrup, so that this sugar is really much more impure than the last, as well as darker in colour. I shall have to say a word on the impurities present in it, and in this I believe I am somewhat singular in my views. I believe the sugar present is not merely pure sugar wetted with a solution or syrup, but I believe in this case some of the impurities are actually in combination with the grains of sugar. Then what becomes of the syrup from this last process? It is now so impure, and contains so large a proportion of bodies which are not sugar at all, that practically it is not worth any one's while to try and get the sugar out of it. Therefore, the syrup from this last portion, a very thick and dark coloured body, is boiled with water, and allowed to cool, when it is called treacle. I have been asked what is the difference between treacle and golden syrup, and I may say that golden syrup is nothing more than treacle passed through animal charcoal and made a little brighter.

Now, I come to the great question of what is treacle? This was a moot point for a long time. Molasses, whether from cane or beet root, possess very much the same properties, and the explanation of their constitution rests on the same basis. Taking refinery treacle as my example, I must first tell you what it consists of. Treacle contains, speaking roughly, about 35 per cent. of true sugar, about 30 per cent. of that inverted or uncrystallizable sugar which is produced by the action of acids or ferments upon cane sugar, about 20 per cent. of water, and about 15 per cent. of bodies that we know little or nothing about, but which we may class under the general name of dirt, but which certainly include many salts of potash and soda. Then you may say, as it contains 35 per cent. of crystallizable cane sugar, why is not that got out in a saleable form and sent into the market? Practically, it cannot be done. It is true that this solution still contains water, and we may regard the syrup therefore simply as a saturated solution of these various bodies in water, and the question is, why do you not continue the operations which were previously performed, and drive off from the treacle, by means of heat in a suitable apparatus, some of the water, making the solution into a supersaturated one, allow it to stand, and then separate the remaining mother liquid from the crystals which were formed? Practically, you cannot do it. You have not got merely sugar and water, but other bodies which require water to hold them in solution; especially those bodies which I call dirt, — mostly uncrystallizable gummy bodies and salts,—and you have besides this uncrystallizable sugar; and all these bodies require a certain amount of water to keep them in solution. If you drive off the water which is required to hold them in solution, you convert this stuff into something like hard-bake. Now, if you had a quantity of hard-bake or toffee with crystals of sugar dispersed through it, it would not be a very promising task to get the crystals out of the mass, and that is what, practically, you would have to do, if you tried to concentrate the treacle much further. Evaporation has been carried to such a point that if you drive more of the water out, the impurities, or those bodies which are not sugar, will simply set solid, and prevent the recovery of any sugar crystals that might be formed, even if you could get them to form. Moreover, even if you were not to drive it to this extreme point, but merely drove off some, and so contented yourself with a very small yield of sugar, you are met by this difficulty, that when sugar is held in a solution containing alkaline salts, chlorides, nitrates, and so on, of sodium and potassium, it actually forms combinations with these salts, and these compounds are bodies which, although they do crystallize, do so with such extreme slowness that, unless you could allow the concentrated mass to stand for a very unreasonable time, it would still all remain fluid, and, accordingly, you are practically unable to win more sugar from molasses on a large scale than is actually done. Of course, in a laboratory experiment it is a different matter, and there possibly you might obtain the whole of the sugar.

I have now treated as fully as I can of the processes to which sugar is submitted in the refinery, although, as I told you, I have not been able to enter into the technical details.

We regret to learn that Messrs. R. L. & A. Stuart, who for forty years have been carrying on the business of refining sugar in this city, and have always stood at the head of this trade, are relinquishing the occupation altogether. It is true that they are among our wealthiest citizens and can retire with ample fortunes, but the absence of their name from the familiar quotations seems almost like a personal loss. We learn that their immense establishment will be sold or converted to other uses.—*New York Price Current.*

THE SUGAR QUESTION IN FRANCE.

The *Conseil Supérieur du Commerce*, in France, lately submitted a series of questions to the "Central Committee of the Sugar Manufacturers in France," relative to the Convention and the duties on sugar. The answers of the Committee *seriatim*, to the questions submitted by the *Conseil*, have appeared in those French journals which represent the sugar industry, and are of so important a character that we append a full translation.

The Central Committee of the Sugar Manufacturers of France, the elected organ of the beet sugar industry, met to consider the answers which it shall give to the questions put by the *Conseil Supérieur du Commerce*, believes that it must in the first place declare its accord with the International Sugar Congress lately held at Brussels.

It finds that the International Convention of 1864 has not attained the end for which it was intended, which was to put the sugar industry and commerce of the four contracting Powers on a footing of perfect equality and agreement.

That the cause which has paralysed the intentions of the Convention is no other than the defective method of assessing the duties, which, instead of being levied on a definite and certain product, are laid on a raw material, of which it is necessary to estimate the probable yield whilst in the refiner's hands.

That the appreciation of these returns is effected by means of a system of types or classes, which affords opportunity for strange abuses, especially as regards the drawback on sugars exported.

To cut short all these abuses and abolish once for all this obscure question of yields and drawbacks, the Central Committee, in agreement with the International Conference, propose, as the basis of a new Convention to be entered into by the Four Countries, *the establishment of the duty on finished sugar*, when it passes into consumption.

This system only, will realize the desired equality, and assure to the Treasury the entire amount of the duty. It will accommodate itself fully to their legislation, and leave full liberty to the respective Governments to modify their interior sugar tariffs without altering the conditions of international competition.

The Central Committee is convinced that the adoption of this *régime* would permit of the French sugar manufacture taking a continually higher stand in foreign markets, especially in one great neighbouring market; and that it would facilitate new developments of an industry which has given such powerful impulse to the progress of agriculture.

A.—Duty on Sugar on Consumption.

I.—What may be the average, in the existing refining industry, of the actual return of each of the four classes of raw sugar at present admitted to a legal drawback of 67, 80, 88, and 94 per cent.? What are the maximum returns of each class?

We are not able to answer these questions precisely. Colour is less than ever a sufficient index of the richness of sugars.

It is on the contrary used as a means of evading the duty.

The skill of manufacturers is applied to making rich sugars of low colour.

The refiner, guided by analysis, pays for sugar of this description in proportion to the excess in richness over the legal yields.

Thus sugars below No. 7 of the legal yield of 67 can be produced, the real standard of which is 74 to 77, and even more; sugars from 7 to 9, legal return 80, of which the true standard is 84 to 86, if manufactured in the vacuum pan, and 90 and even 92, if made in the open air. One refiner has recently bought 5000 bags [7 to 9, the legal yield of which is 80 per cent.], at an average standard of 88·10 per cent.

It is the same for the other classes of sugar.

The richest sugar of lowest colour is highest in price. Thus there are on sale at this moment—

Sugars below No. 7	80 to 81	francs on the 88°	standard.
„ from 7 to 9	78	„	„
Whilst those from 10 to 14 are worth	75	„	„
And those from 15 to 19 „	73	„	„

But we must say that the extra value indicated by this table is above the average, the effect of certain commercial circumstances, notably of the traffic in certificates of exportation. However, already for the next season, sugars from 7 to 9 have been bought for delivery at a marked advantage.

All sugar which is richer than the legal return of its class is declared for temporary admission. Sugars which only reach the standard of their colour are generally depreciated and left to the foreign trader.

We should add that by means of the osmose process, which removes the salts and darkens the sugars, sugars are produced of inferior colour, the standard of which is so much higher, in proportion to the diminished quantity of the salts.

From these considerations, it appears that as consequences of maintaining the *régime* of types, the production of red (or brown) sugars would increase and the progress in manufacture would be hindered.

II.—If the actual returns are sensibly below the legal returns determined by the colour of the sugar, would the interests of the Treasury be protected by raising these returns and by increasing in equal proportion, the duties applicable to raw sugars on going into consumption?

The colour does not serve to determine the exact richness, and all classification which does not rest on this basis is faulty, and the increase of the legal yields would only have the effect of making it further to the interest of the manufacturers to introduce artificial colouring.

Whether the legal returns were raised or lowered, all the sugar which ought to pay duty would never be exactly reached, and the modifications in the classes would induce modifications in the manufacture.

Another consideration: The richness of a class varies according to the locality and according to the modes of manufacture, it follows that the duty imposed on the average returns might be sufficiently exact as regards the Treasury, and be unjust to certain manufacturers.

III.—Would it be convenient to increase the number of classes in order to reduce the proportions between one class and another?

The increase in the number of classes would be insufficient,—a restraint on the manufacturers and a source of difficulty in the sale;—it would increase the most crying abuse of the system of types, the re-classing after purchase. If the re-classing is practised on four classes of sugar, each containing many numbers, it would be much more frequent on 10 or 12 distinct classes separated by slight difference of colour, and that all the more, inasmuch as there never has been uniformity in the types from one year to another, nor between those of the same year from one factory to another.

IV.—If it was desirable in preference to the present system to adopt the Excise in refineries, what measures would it be needful to take in the great centres of population where refineries are placed, to prevent the removals which might be attempted by clandestine or other means?

The Excise in refineries is not a new institution. It was practised from 1853 to 1864; it is still in use in the factory refineries. There exists on this subject some complete instructions (see the Circular of 15th December, 1853, No. 20). The Excise of refineries ought to profit from the progress which experience in the sugar factories has realized.

Thus in the factories to-day less importance is attached to the account of *entrée* or *prise en charge*; it is surveyed, and the subsequent operations followed, but special attention is given to the warehouse.

The organization of permanent or continuous service has had this result, that not a kilogramme of sugar has escaped the duty; and the effect of it has been so complete that since then, not an accusation has been laid to the charge of any manufacturer.

Those who know on what a scale fraud was formerly practised, will acknowledge this result to be one of considerable importance, not only to the Treasury but especially in a moral point of view. Permanence gives to those employed such experience of the working, that if there were any fraud they would be able to discover it, and even to indicate the point where it had taken place. It is then possible to organize the Excise in the refineries; it suffices that the entry into and the exit from the warehouses shall be kept exactly the same, and under the charge of the same permanent surveillance, supported and controlled by the preparatory account of the *prise en charge* and by the oversight of the intermediate operations.

V.—The excise is only suited to periodic returns. How can these returns be made in the factories which work night and day without interruption throughout the whole year?

The actual organization of the Excise allows of their taking account at any moment of the position of the sugar factories. The stock in the warehouse where the finished sugars are placed is always exact. The stock of the syrups in crystallization is taken approximately by the daily estimate of the average return.

The same means of control could be carried out in refineries, and there would be no need to stop the working to take stock periodically. Occasionally, advantage might be taken of accidental stoppages to make the returns more complete. But as to the fears founded on prejudice which would impose on these establishments the necessity of stopping their works to make an annual return, they cannot be considered as serious when it is well known that refineries (and notably partnership refineries) easily find means of taking stock without injury to their working.

VI.—Do you approve of applying one duty to all the produce of the refineries? Or rather, which is more probable, would you tax differently, candy, loaf, white sugar in crystals or powder, and yellows, according to the degree of saccharine richness of each of these products?

VII.—In the last hypothesis, on what base of classification, and to what mode of verification, would you have recourse?

A single duty would be a great simplification, and the Committee has hesitated a long time before rejecting it. However it has found, that in the interests of consumers and of manufacturers, and to encourage the consumption of raw sugars, it might be of use to propose the establishment of two classes, to be distinguished as under.

1st class sugars—Candy, and loaf sugar, a uniform duty of 70 francs.

2nd class—All other sugars without distinction, 65 francs. The Central Committee has thought that these duties, notwithstanding the proposed reduction of the duty on refined, would be more productive than the whole number of classes indicated in the *projet de loi*, now submitted to the Assembly.

VIII.—Under what system would molasses be placed?

Molasses would remain on the same footing as before.

IX.—As it might not be wished to prevent chocolate makers, confectioners, preservers of fruit, or even simple consumers, from using sugar not refined, what system of tariff should be applied to the raw sugar thus kept away from the refineries?

Sugars used for chocolate, confectionery, &c., would pay the duty on consumption on their class. Chocolates not enjoying any drawback, there would be no change as regards them.

X.—The Excise in France implies the adoption of an analogous system in England, Belgium, and Holland; what precautions would it be needful to take to guarantee to the sugar manufacturers of each of the four countries, that the conditions of fair competition should not be troubled by frauds or connivances in any of the other countries?

If the system of permanent Excise is applied in the three other countries as in France, all necessary guarantees would exist to insure the conditions of fair competition. It would be incumbent on the International Conference to discover a common *régime*, which would be accepted by all the four countries.

XI.—Besides all fiscal questions, what are the advantages or inconveniences which might be found in the Excise, by the manufacturers of beet sugar, the importers of foreign or colonial sugar, and the refiners?

As regards exterior commerce, the duty on consumption by suppressing all drawback, makes the causes of inequality (which give some advantages to the refiners of certain countries,) to disappear. In this respect, then, it realises completely the aim which the Convention of 1864, had in view, and which the actual *régime* has not permitted the attainment.

As to the Interior, raw sugars would in future be only bought by the proportion of sugar which they actually contain, and no longer by the bounty to which their class might give a right. This system would leave to manufacturers, as to refiners, full liberty to carry on their works and their commercial operations.

XII.—Has the Convention of 1864 produced such advantages to the manufacture and commerce of France, as to make it desirable to maintain this Convention?

It is needful to distinguish between the principle of the International Convention, which is that of liberty of commerce between four neighbouring nations, (a principle fruitful in good results,) and the means of its application, which are very defective. These means have allowed some inequalities of condition to subsist between competitors who expected to combat on equal terms. Hence the complaints of the Convention which have been heard on all sides.

XIII.—What are the expenses of sending raw or refined sugars from Belgium, France, and the low countries into England, or from this last state into the other three?

The information which the Central Committee have been able to procure as to the expense of transport, &c., of 100 kilogrs. of refined sugar from Paris to London, show that these expenses are at present nearly 4 frs. 50 cents (1s. 10d. per cwt.).

B.—White Sugars not Equal to Refined.

I.—Is it of serious importance that the exportation of *Poudres blanches* should be permitted in discharge of the obligations of temporary admission?

II.—In case of an affirmative, at what must the return be fixed?

These questions confound two things essentially distinct: temporary admission and exportation with drawback; we ask that the situation shall be entirely altered. As it is, it shows the complications and the difficulties of the actual system.

C.—Surtaxe on Navigation.

I.—Would it be desirable to free foreign sugars from the *surtaxe* of the flag, from which sugars from the French Colonies are exempt by virtue of the law of 30th January last?

II.—Should this freedom be extended to sugars of all kinds and of all origins, imported by sea or land?

The *surtaxes* on the flag were established for the benefit of the shipping and not in favour of the French sugar industry.

If the Government propose to abandon the system of *surtaxes* on the flag, the sugar industry can have no objection.

Otherwise if the *régime* is continued, we do not see how foreign sugars can be exempted. We may add that the nations who have not adhered to the National Convention have put higher duties on French sugars than we have on theirs and for this which constitutes a protection, our *surtaxes* on the flag would be an insufficient compensation.

III.—Is it advisable to abolish the prohibition which is the result of the last paragraph of Article 6 of the law of 7th May, 1864, which excludes from the benefit of exportation after refining, colonial and foreign sugars, when they have not been imported directly by sea from countries beyond Europe?

It is necessary to take account of the reciprocity of treatment applied to our products in certain countries. It would not, perhaps, be very inconvenient to suppress the prohibition which applies to the sugar of Belgium and Holland, if on the one side Belgian coal, so necessary to our industry, were not taxed on its entrance into this country, and if the sugar factories of Belgium by adopting the Excise could no longer enjoy their great advantages; and if on the other hand the Dutch sugar factories would relinquish some of their privileges.

But it is impossible to consent to this suppression when it relates to the sugars of Germany and Austria, when it is well known that large bounties are given on exports from those countries. Egyptian sugars on their side appear to be produced under conditions which would demand the application of the interdiction to them, although imported by sea from beyond Europe. These sugars were certainly not contemplated by the 6th Article of the law of 7th May, 1864. They did not then exist, and they now seem to threaten a very great increase.

IV.—In the case where the *surtaxe* should be maintained, ought we not, contrary to the provisions of the last paragraph but one of Article 5 of the Law 7th May, 1864, to reimburse it entirely on exportation after refining, in order to maintain the equality established between the four contracting powers by the Convention of the 8th November, 1864?

If the *surtaxes* of the flag should be maintained, the Committee think that there would be no occasion to carry out the system of reimbursements on exportation.

Signed, F. Georges, *President;*
E. Vion, Abel Stievenant, *Vice-Presidents;*
J. B. Marriage, *Secretary;*
Belin, Delaunay, L. Dervaux, Durin, Hallette, Marquis d'Havringcourt, Linard, de Mot, Vallet, Woussen, *Members;*
E. Fievet, *Fabricant-raffineur.*

SUGAR CANE.

NEED OF NEW SEED CANE IN LOUISIANA.

An old and experienced planter of this State calls our attention to the degeneration of the ribbon cane, almost exclusively used by our planters, and affirms that much of the deficiency in the product of this staple is due to this cause. This degeneration he ascribes to bad cultivation and deficient labour and drainage, and to the necessity of the planters using inferior cane for planting. It is deemed of great importance that this degeneration should be arrested, and to that end it is proposed to send to India for fresh and new plants, so as to improve our stock, and restore the large production of former times.

The ribbon cane of late years has entirely changed its colour, and its juice has lost its original aroma. It is no more the original cane imported to this State by Judge Borrin in 1810 as a curiosity. It was brought direct from Java to Charlestown or Savannah with a cargo of coffee, and adapted itself so well to our climate, soil, and cultivation, that it rapidly superseded the old stock, which had been long in use by the planters. The present degenerated ribbon cane is now more delicate and puny in its growth, more easily affected by frost, and more subject to decay in windrow or mattresses, put up for seed. The stubbles will not keep sound after the first year. In fact, the juice tastes like sorgum or cornstalk juice, and requires more boiling to make it granulate, and yields double the molasses it used to do. In short, it is getting worthless.

Even higher cultivation and fertilizing have failed to restore the original vigour of this cane, and bring back its bright stripes and its aromatic juice. The juice, too, makes far more molasses than sugar.

Many experiments have been made to introduce new canes into our State from South America and the West Indies, but they have generally failed. The creole from Madeira, ottaili from Cuba and Brazil, ribbon cane from Tehauntepec, Guascacala, Tampico, and the Pacific Islands. None of these suit our climate. The rind of all of them is too thin, the eyes too small and weak, the roots not strong enough. Nothing has stood the test of our climate and soil so well as the ribbon cane from Java, which saved the sugar cultivation in this State after 1830.

Many years ago our Government, at the suggestion of Mr. Lapice and Gov. A. B. Roman, introduced, through the Agricultural Bureau, some cane from Penang, India. This was done at enormous expense, and a few of the eyes falling into Mr. Lapice's possession, he cultivated it with great success for three years, but the first hard frost killed it. There are, however, other canes in India, of a superior quality, and which mature early; and it is believed their introduction would be a vast benefit to our planters. It is proposed, therefore, by a combination of our planters, to employ some experienced person to proceed to India, and after ascertaining the best stock in that country, or in Java or Sumatra, to import a sufficiency thereof for the use of our planters. For this task we know of no person so competent as Mr. Lapice, whose proposition we take pleasure in laying before our readers, and commend it to the favourable consideration of all who are interested in the sugar culture.

It would be necessary for him to go by the Suez Canal, by Oriental mail steamships of England or France, to go by Marseilles to Singapore, and return the same way, to arrive here in time to plant the canes in December or January next, and to know how to pack them so as to keep them sound and fresh. The passage, freight, &c., will be very expensive, probably, not less than 5,000 dolls., which could be raised by fifty subscribers at 100 dolls. each. He would ask one-half of all the canes he succeeded in bringing here for his trouble and compensation, and divide the other half among the subscribers free of charge. It would be a most judicious expenditure for any sugar planter to make, to employ a competent and experienced sugar planter to make the selection; and not do as our Government did in sending a vessel to the West Indies, Brazil, and South America to bring here worthless canes inflicted with the borer.—*N. O. Times.*

ON THE RESULTS OBTAINED BY THE OSMOSE PROCESS IN RUSSIA.

By M. Eugene Feltz.

We have just finished passing through the centrifugals 240,000 kilogrs. of thirds molasses osmosed; as in preceding years, the osmosing of these products has produced excellent results, increased this year by the exceptional price of pieces. The thirds not osmosed gave 9 to 10 per cent. of yellow pieces, whilst the osmosed thirds have yielded 20 to 25 per cent., on the average above 22 per cent. The ordinary thirds took three months to crystallize, whilst the centrifugaling of the osmosed thirds was effected three weeks after the boiling. For comparison, let us take the following results:—

15,000 *pouds.* thirds molasses, not osmosed, gave yellow
sugar .... 1500 *pouds.*, at 5 roubles, = 7500 roubles.
13,000 *pouds.* thirds molasses
osmosed, yielded yellow
sugar .... 3000 ,, at 5·5 ,, 16,500 ,,

The cost of filtration, carbonatation, fuel, paper, labour, &c., did not reach 1500 roubles. Thus, there was a nett increase of value of 7500 roubles. If account is taken of the comparative rapidity of crystallization, which allows of the sugar from 13,000 *pouds.* of thirds being sold now rather than three months hence, we must add to the nett profit 1500 roubles at least.

The great advantage of the osmose process applied to the drainage of the seconds and thirds boilings, is that it requires very little extra labour, because it is needful to boil and centrifugal these products, either with or without their being osmosed. The labour necessary for the osmogene is largely compensated by the much greater facility with which the osmosed products pass the centrifugal. Instead of obtaining *masses* more or less sticky like ordinary thirds, we obtain after osmosing, crystallized *masses* easy to centrifugal, and sugar of superior value. I have estimated one at 5 and the other at 5·50 roubles.

I have also passed through the osmogenes 160,000 kilogrs. (160 tons,) of fourths molasses (drainage of thirds not osmosed,) boiled during the manufacture. I have submitted them to a good filtration and to the Wœstyn form of calco-carbonic clarification before the osmose. The crystallization is, as you would suppose, slower than in the thirds, but the appearance of the pans promises a return of 12 to 15 per cent. of sugar. It is needless to say, that the osmosing of fourths has to be more thorough than that of thirds.

I have read with attention the instructive article published by M. Dubrunfaut in your number of February 4th, (see *Sugar Cane,* for April,) and I have seen with pleasure that the enlightened manufacturers who have used the osmose process for many years have remained faithful to the only economical practice of it, working with loss of the exosmose waters. The first steps of the osmose were hindered by the idea of making the waters so strong as to be able to boil them into molasses. This method can have no serious advantage, except when a distillery forms part of the factory. M. Dubrunfaut's article appears to assert that the working with loss of the waters cannot be applied to a very thorough osmose. Happily there is nothing in this. The process is more satisfactory than its inventor appears to believe.

It matters not what product of the manufactory is worked with loss of waters, to obtain waters containing at least one part of salt to one of sugar, that is to say, waters of the co-efficient 1. It is only scarcity of water which would force manufacturers to work with strong water. Here are some figures relative to a trial of the osmose of some fourths, during last year, but of which I am unable to give complete returns:—

The original molasses contained..	35·65 of salts per 100 of sugar.			
The molasses osmosed contained..	19·75	,,	,,	,,
The osmose waters............	585·00	,,	,,	,,

According to the mode of calculation employed by M. Dubrunfaut we should obtain the probable return in the following manner:—

The original molasses contained 43·5 per cent. of sugar, and

15·55 per cent. of salts. There has been extracted by osmose 15·55 × ·045 = 7 per cent. of salts: at the co-efficient 4 there has been rendered crystallizable 4 × 7 = 28 — 1·5, say 26·5 per cent. of sugar. We see that the purification was strong, notwithstanding the idea that good waters (of exosmose) had to be made. The molasses entered the osmogene at 40·6° Baumé, and issued from it at 18° Baumé.

By working more slowly, it would have been possible to lower the molasses to 13° or 14° Baumé, and obtain a still greater purification.

Only as my model apparatus is very small, the thread of molasses at 40·6 was excessively weak to begin with, and in a great number of apparatus the working would have been of very little value. The density of the water being lowered at least half a degree in the cold, the co-efficient 1 may be obtained, even with the molasses issuing from the osmogene at 15° Baumé. As a kilogr. of steam raises 6 kilogrs. of water to 90° C., (194° F.,) and does not evaporate a single kilogr., it will always be more economical in a non-distilling factory, to osmose with loss of the water.

The osmose process acts very little on organic matters and cannot therefore be applied indefinitely to the products of the refinery, but applied to sucrates of lime it allows of purification much more radical in character. It is thus, that in a trial of this kind on some kilogrammes of fourths molasses, I was able to obtain syrup of sufficient purity, without any filtration whatever, to boil to crystals in the experimental apparatus of my laboratory.

But the economical conditions of this process are not sufficiently favourable to permit of its working on a large scale in our factory. However, the using of osmogenes is so regular and of such slight expense, that the employment of the osmose as a process of purification, should be introduced into sugar factories, as well as the charcoal filtration.—*La Sucrerie Indigéne.*

METEOROLOGICAL OBSERVATORY IN BARBADOS.

At the opening of the present session of the House of Assembly in Barbados, His Excellency Governor Rawson propounded a scheme of considerable importance not only to that island, but to the whole of the West Indies. This was the founding of a Meteorological Observatory for the purpose of observing and making known by means of the telegraph to all the neighbouring islands and coasts, any sudden atmospheric changes which might predicate danger from approaching storms or hurricanes.

This proposal of Governor Rawson's has met with almost universal approval, at least within the regions which are subject to these terrible visitations. Lord Kimberley has officially notified his approval of the scheme, and suggests that a small remuneration should be offered to any civil servant or citizen of ordinary intelligence to make and register the observations, respecting which the *Barbados Globe* observes that citizens and civil servants have their time pretty fully occupied, and that it may very well happen that phenomena of great interest and moment, and requiring continuous watching, may be taking place at the very time when the prime duty of the citizen or member of the civil service demands his presence and attention elsewhere than at the observatory.

Regarding the general subject and the proposed scheme, the following extract from the *Barbados West Indian* will be read with interest.

"We know not a more convenient place for a Meteorological Observatory, for the special object it is designed to serve, of giving warning of approaching storms and hurricanes within the Tropics, than Barbados affords, situated as it is a little outside of the chain of islands that extends from Trinidad to the Bahamas, separating the Caribbean Sea and Gulf of Mexico from the Atlantic. The Telegraph Stations fixed on each island, would form links of communication for the conveyance of intelligence of atmospheric disturbances, all along that portion of the Atlantic where these hurricanes prevail. Their course is almost invariably in the direction from S. E. to N. W. and their ordinary rate of motion from 20 to 40 miles an hour, so that notice of their approach can be given from one island to another by hours, and from one extremity of the chain to the other by days, giving time for preparation on land and sea, to guard against the danger, and for the protection of life and property. In the hurricane of 1831 in this island alone 1,200 persons were killed, and immense loss of property was occasioned, in a great measure owing to the burst of the storm upon us, without any warning, to permit of precautions being taken against its violence. Hence it was, a number of vessels lying at anchor in Carlisle Bay were driven on shore, houses unroofed, because the doors and windows were left unfastened, animals killed by the falling of the insecure buildings in which they were placed, and the lives of men, women and children sacrificed in the terror and confusion of the storm, as they vainly rushed out of their houses to seek for safety in the open fields. In such a peril to be forewarned is to be forearmed. Much of the danger and the devastation occasioned by the hurricane is capable of being guarded against by timely warning, and this is what might be obtained by the establishment of a Meteorological Observatory here, which as Mr. Rawson says, would be a beacon to all the travellers over these seas, and to the inhabitants of the neighbouring shores. As there are soundings taken of the depths of the ocean, and the direction of currents in these seas is known, so observations have been made and records kept of the prevailing winds, and of the periodical occurrence of those rotatory storms which are so destructive in these latitudes, of their rise and progress, and the rate they travel at over the expanse of the ocean. The suggestion of the establishment of an Observatory here to note these phenomena fully, as well as the changes of weather, and to forward intelligence of them, all through the chain of islands, and along the seaboard of the United States, to give warning of the approach of hurricanes, has been favourably received at Washington, as likely to be of great benefit in the protection of life and property in the Southern States, and a valuable source of information in meteorological enquiries. Notes of the changes of the weather all over the continent of North America, are taken in different places and forwarded to Washington, and are useful for sanitary and agricultural purposes, as well as for the advancement of other science. To extend the range of observation to the South Atlantic and the mid ocean, where at certain seasons and intervals of time the hurricane arises as if from its sleep in the waters, and sweeps along the path of the Gulf Stream to the Atlantic seaboard, will be a great addition to the means at present available for researches in Meteorology, especially for acquiring more accurate knowledge of the law of storms. A correspondent writing on the subject, anticipates a difficulty in the expense to which the establishment of an Observatory would put this island; but we think he scarcely does justice to the liberal spirit that the Legislature has exhibited, in the erection of another Lighthouse on the windward side of the Island, at a much greater cost, not many weeks since; in the subsidy to the Submarine Telegraph Company, voted without a dissentient voice some couple of years ago, and in the 'invaluable boon' the inland Post office."

THE COLONIAL COMPANY (LIMITED).

The seventh ordinary general meeting of the shareholders was held on Thursday last, at the offices of the company, No. 16, Leadenhall Street; the chair was occupied by the Right Hon. E. P. Bouverie, M.P., the chairman of the company. The notice calling the meeting was read by Mr. Thomas H. Glennie, the secretary. The report of the directors, which was taken as read, was as follows:—

"The following is the result of the company's operations for the past year:—The gross profits have amounted to £111,365 7s. 11d.; deduct the charge for business expenses and interest on debentures, £36,160 11s. 2d., there remains a net profit of £75,204 16s. 9d.; add balance of profit and loss brought forward from last year, £163 19s. 6d.; total £75,368 16s. 3d. From this has to be deducted—interest due to vendors on amount credited in advance on the 10,000 shares allotted to them under contract, at 5 per cent., £1,250; *ad interim* dividend of 10s. per share, declared July, 1871, £12,759 10s.; *ad interim* dividend of 10s. per share, declared January, 1872, £14,759 10s.; leaving a balance of £44,599 16s. 3d. The directors recommend that a further dividend of 12s. per share be now declared, which will amount to £17,711 8s. The total dividend thus declared, being 32s. per share, is at the rate of 8 per cent. per annum. The directors propose that the dividend for the year be free of income-tax. A further sum of £5,000 has been transferred to the reserve fund, making a total reserve of £95,000. The balance of undivided profits to be carried forward to this year's account, after providing for bad and doubtful debts, will be £21,888 8s. 3d. The results of the past year compare very favourably with those of the preceding, arising from satisfactory crops, and fair prices for produce. The directors regret that the prospects for the current year are less satisfactory, owing to unfavourable weather which prevailed throughout the British West Indies towards the end of last year. The general commission business of the company has been fully maintained during the past year. For some years past, the directors have been closely watching the progress of the Central Sugar Factories in the French Islands of Guadeloupe and Martinique, where the manufacture is centralised, and the agriculture separately conducted; and they have from time to time had them inspected and reported upon by practical persons in whom they had confidence. These reports have invariably testified to the success of these establishments, and were last year fully confirmed after a visit to these islands by one of their own body. The directors, therefore, determined to erect one in Trinidad, which is now in course of construction, and which will, it is expected, be in a position next season to take off the crops of several of the company's estates. These crops have hitherto been manufactured separately in different sets of works, and of a quality suitable only for refining, and will in future be made of a fine quality and in one factory, which it is believed will result in increased economy and profit. During the past year, the directors have sold three of their outlying estates in Trinidad, and it will be satisfactory to the proprietors to know that a higher price was obtained for them than was originally paid. A portion of the debentures of the company fall due at the end of the year, and the directors propose to renew the whole, or a considerable portion of them. The board have thought it desirable that an arrangement should be come to with regard to the £2. 10s. credited in advance on the vendors' shares, a proposal is submitted herewith for this purpose. In accordance with the articles of association, two of the members of the board retire at this meeting. The retiring directors are Wm. Burnley Hume, Esq., and Neville Lubbock, Esq., who being eligible, offer themselves for re-election. Warrants for the additional dividend of 12s. per share will be issued on the 8th July next; together with the usual *ad interim* dividend of 10s. per share for the six months ending 30th June instant, being at the rate of 5 per cent per annum."

The Chairman, moving the reception and adoption of the report, said the shareholders would observe that his favourable anticipations as to the year 1871, when he had the pleasure of meeting them twelve months ago, had been in great measure realized. At that time the prospects were good and the prices fair, so that on the whole they expected to do well. This had been the case, and last year had been on the whole the best year the company had had.

Prices had not been very high, but crops had been good, and a larger amount of business had been done than usual. The gross profits had been £5000 more than in 1868, hitherto the most favourable year of the company. The imports of sugar generally last year had been larger than in any previous year, and so it had been from the company's estates. The price obtained by the company had been good, being the same as the average price of clayed manilla for the last six years, viz., 21s. 0½d. per cwt.

The large amount carried by the directors to the reserve fund and to the present year's account was in accordance with the same policy as led them last year to divide the whole of the profits of 1870. Then, though the profits had been smaller, the prospects were good; this year the prospects were not so bright, the present crops from the West Indies generally having been much affected by the unfavourable weather.

The directors, seeing the prosperity of the central factories in Martinique and Guadeloupe, were now erecting one in Trinidad, where the company had several estates favourably situated for such an undertaking. Besides the direct profits expected to be made, it was hoped that by laying down several miles of railway from those estates to the factory, the crops might be taken off more expeditiously, an important point in Trinidad where the crop season is very short.

With respect to the £2 10s. 0d. per share credited on the Vendor's shares, it was proposed that this amount should be wiped off and all the shares be placed on an equal footing. The plan proposed was to pay the Vendors the £2 10s. 0d. per share, and that amount would be paid to them not in cash but in Debentures, at 5 per cent with 5 years to run.

The Chairman also referred to the sale of the outlying estates, and to other strictly financial matters connected with the company; in conclusion, he formally moved the adoption of the report.

Mr. Robert Gillespie, Deputy-chairman, supported the resolution, which was warmly supported by Mr. Simpson, and carried unanimously. A dividend of 12s. per share was declared, making with the *interim* dividend already paid, 32s. per share for the year, being at the rate of 8 per cent. per annum.

The retiring directors, Mr. William Burnley Hume and Mr. Neville Lubbock, were then re-elected; and Messrs. Price, Hoyland and Waterhouse re-appointed auditors of the company.

A cordial vote of thanks was passed to the chairman and directors for the excellent manner in which they had conducted the business of the company.

The meeting was then made special, and a special resolution carried authorizing the necessary alterations in the articles of association, to enable the directors to carry out the arrangement with respect to the vendors' shares. The meeting then separated.

THE SLAVE TRADE IN POLYNESIA AND AFRICA.

Much has been said and written respecting the slave trade in the islands of the Pacific, especially since the murder of Bishop Pattison, and it has been assumed that the slave trade is inseparably connected with the immigration of natives into our South Australian colonies, where the cultivation of sugar, &c. requires other than European labour, and that as long as there is immigration the slave trade will continue. There is no foundation whatever for this assumption; in fact, were a well organized system of immigration carried out between the islands of Polynesia and our Australian colonies, where labour of that kind is required, there is no doubt but that it would be a better means than has yet been employed of putting an end to the slave trade in those parts. Our attention has been called to this by the receipt of a small pamphlet on the subject, reprinted from the *Brisbane Courier*. The writer appears to have to defend the immigrant system against some of his fellow colonists who think that the immorality of the traffic cannot permit it to be continued, that coloured labour competes improperly with white, and that "the abasement of the dignity of labour by the employment of an inferior race does a country incalculable mischief," and that the political system of the colony "does not harmonize with the introduction of a class of mere labourers who can never rise to the dignity of free citizens of a free community, but must ever remain excluded from those political rights which are our most valued inheritance." A man can do only what he is fit for in the world, and if a Polynesian, though, as it would seem, incapable of understanding a ballot box, can plant and cultivate canes, and bear a kind of labour which the European who has an instinctive knowledge of political rights of all kinds is not fitted for, surely the Polynesian is not entirely useless in the world. This may be shown by a few facts given, in the pamphlet named, by Mr. De Poix-Tyrel, who says :*—

"On Monday last, I put twelve white men planting cane in one field, and twenty Kanakas (Polynesians,) at similar work in another. The drills were marked out, the plants carted to the field, the same manuring had to be done, neither party had any overseer working with them, and in neither case was any mention of competition used as an incentive. The Kanakas planted four and a-half acres, the white men two and one-third, so that each white man fell considerably short of the amount done by each Kanaka. At trashing cane, which I believe to be more essential to sugar making than is generally recognised, the results are still more in the Kanakas favour; and indeed it is difficult for white men to keep at work for any time, as their hands and arms suffer from the cane itch and are cut by the hairy leaves. A white man on contract work, such as clearing, fencing, or any other work, when the amount done determines the amount paid, will, I believe, do more than a Polynesian, but in every instance where I have employed them in gangs for weekly wages, I have found that they did less than an equivalent number of the inferior race. Then, as to cost. We are paying white men 15s. per week and rations, which is about £52 per annum. The Kanakas get £6 per annum wages, their food and clothes, and £15 for passage each way, extended over their three years' term of service, cost about £22 per annum. To keep a plantation of this size, 200 acres being under cultivation, in proper order, would require a permanent staff of thirty-five Kanakas and five white men. This is of course exclusive of extra hands at crushing. This would cost in one case :—

	£
35 Polynesians, at £22 per annum............	770
5 White men, at £52 „	260
	£1030
And in the other, 40 white men, at £52 per annum	£2080

"So that the heavy expenses for field work would be more than doubled; it would certainly not be done more efficiently, and there would be the danger we unfortunately always find among white men working in gangs, of sudden strikes and suspensions of work, at any trifling causes of discontent."

How the Kanakas now employed are obtained Mr. De Poix-Tyrel does not state, but if Queensland is likely to become a sugar growing country, that is, to grow sugar as its staple, and thus require a large amount of other than white labour, it will be needful for the colonial Government to take in hand the immigration question, and there is no doubt but that a well devised scheme properly carried out, would tend not only to the prosperity of the colony, but would be of even greater advantage to the Polynesians themselves.

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* "Polynesian Labour and the Slave Trading in the Pacific," by J. De Poix-Tyrel, J. P., Redland Bay, Queensland.

As regards the East African coast, it is well known that an extensive slave trade is carried on between several countries there situated, and Arabia, Persia and elsewhere. Surely when there is such a large supply of labour surreptitiously bartered by the native rulers, something might be done towards turning it in the direction of some of our colonies, on a different principle of course. It appears that several men-of-war are employed on that coast in endeavouring to prevent the slave trade, but that the result of this "armed intervention" is that only about 5 per cent. of the slaves are rescued. On this subject, *The Natal Mercury*, speaking of the postal service projected between that colony and Suez, has the following remarks:—

"The annual meeting of the Chamber of Commerce did well to devote its attention chiefly to the projected eastern mail route. There is not at present before our mercantile community a topic of more substantial importance. A monthly postal service *via* Suez is in itself no ordinary boon; but the establishment of a regular steam communication with Mozambique and Zanzibar will directly or indirectly be a benefit to the whole colony.

"We have already shown that the Home Government will take action so far as Zanzibar and Aden are concerned. It is prepared to do this on grounds of policy as regards the suppression of the slave trade, and on grounds of economy as regards the cost of the present squadron. But it naturally would prefer that a through service along the entire coast should be organized, as being a more repressive agency in preventing slave trade, and a saving of expense to the Imperial Exchequer. Unless it be ready to make confession of utter failure as a modern colonising power, Portugal could not fail to avail itself of such an opportunity to secure regular postal communication with its East African dependencies. The subsidy required will, therefore, be payable from four sources—England, India, Portugal, and Africa, the first three probably contributing the lion's share. Thus it is that the share likely to fall upon Natal, as stated by Lord Kimberley, is so moderate and, in our opinion, so inconsiderable when compared with the advantages to be gained.

"Of the trade done at Zanzibar, we have already spoken, and shown that it is susceptible of indefinite expansion. So also of Mozambique commerce. Although the exports from that province at present represent an estimated money value of £120,000, these figures are merely a criterion of what to a much larger extent might be expected had foreign enterprise full and free play. Portuguese sloth and apathy would contend vainly with the energising influences of frequent contact with a busier world. The present condition of those east coast settlements—a condition of vicious stagnation—is largely, if not wholly, due to their isolation from the world. They are cut off from the vitalising influences of civilisation by their inaccessibility. They never figure in any shipping list: postal time tables make no mention of them; gazettes are silent as to their being. Although three centuries have elapsed since their establishment, they are incomparably behind colonies that but forty years ago were the undisputed homes of the savage. Had there been frequent communication with these ports, they would not have been thus isolated and backward. Men of enterprise would have found them out. Competition would have invaded them. The pressure of events would have compelled these governments to break through the traditions of a rotten system, and conform to the liberal and enlightened usages of other countries.

"But there is an element of solid advantage in this project, not mixed up with trade. We refer to the Labour Question. These steamers ought to be the means of large and material relief to our labour market. If native labourers can pass to and fro without difficulty, their disposition to come this way, and find work for a time on these southern plantations, will be encouraged and stimulated. In the region beyond Zanzibar there is an inexhaustible labour supply. This is proved by the fact that 20,000 slaves are shipped from thence to Madagascar, Arabia, and Persia yearly. If some portion of this vast number could be brought this way as free labourers, with full liberty to return, and under all necessary and proper provisions for their safe keeping and fair treatment, the Sultan of Zanzibar might find that such an emigration was far more lucrative to him, and advantageous to his dominions, than an infamous traffic carried on surreptitiously and with great difficulty. The revenue derived by the Sultan out of the 20,000 slaves, whose shipment to the east he connives at, is but from £10,000 to £15,000, or about 10s. to 15s. per head. The charges paid in India on each coolie sent abroad, without reckoning the cost of passage, amount to very much more. The best authorities concur in saying that the Sultan would, probably, accept £10,000 as compensation for any revenue he might lose by the stoppage of the slave trade; but the substitution of free emigration for slave shipment would be a far more legitimate form of composition. As the steamers employed along the Suez route will have to be of some size, they will probably have capacity for carrying two or three hundred deck passengers each trip, as do the Levant and Red Sea boats, as well as the vessels running between the different ports of India and China. We have indeed very little doubt that a large coastal passenger traffic would ere long be created when once the natives found that they could pass to and fro quickly, cheaply, and without official hindrance. The Arabs of Zanzibar would probably be the first to make use of the money making opportunities which they could hardly fail to observe in this direction; and it is equally probable that they would be the first to take up the labour question."

Some time ago, a letter appeared in *The Sugar Cane* on the advantages which would result from Negro or African over Coolie immigration into the West Indies, because of the superior physical powers of the African race, and of their greater ability to stand the climate. If the labour supply on the eastern coast of Africa is so great, and if means can be found of organizing a free immigration into Natal, perhaps it might without much greater difficulty be extended to our West Indian colonies, where the demand for labour is so much greater. The distance being less than from Bengal, the expense need not be greater than the transport of Coolies. Doubtless there would be much greater difficulty in carrying out a system of free emigration from a country whose only ruler is a barbarous despot accustomed to sell his subjects, than from Bengal where it is regulated by the British Government; and there would be a danger of the system becoming in the hands of the traders of some nations, very little better than the present slave trade with Arabia and Persia. There would besides be difficulty about the labourers being brought to the coast from the interior voluntarily; but these difficulties are not necessarily insuperable.

THE BEET-ROOT SUGAR INDUSTRY IN THE UNITED STATES.

The question of the desirability of the general introduction of the beet sugar manufacture into the northern parts of the United States and into Canada, has been under consideration for some time past, in several localities. The subject has undergone very close investigation in the Massachussetts Agricultural College, where several varieties of sugar beets have been grown upon the College farm, and sugar manufactured from them on the premises. The results of these experiments have been fully reported by Prof. Charles H. Gœssman, Ph.D., in three late numbers of the *American Chemist.*

From this report we extract some passages, chiefly confined to accounts of the experiments, conducted by Dr. Gœssman himself, relative to the growth of the beet, the study of the chemical properties of the beets grown, and to the actual manufacture of sugar therefrom. 1st. As to cultivation :—

"The field selected for the cultivation of the sugar-beets consisted of four and seventh-tenths (4·7) acres, which sloped gently towards the west; the soil was a warm sandy loam, with the exception of the south-west corner, which being wet, was subsequently planted with various kinds of common mangolds. Grass had been raised upon the land for several years, until the fall of 1869, when it was ploughed and a good coating of coarse yard manure put upon it. In the spring of 1870, it was planted with corn, each hill received a handful of a phosphate manure, and 70 (seventy) bushels of corn, per acre, that year. It was, thus, in consequence of a suitable selection of manure and a satisfactory preceding crop, in a desirable condition for the production of sugar-beets. During the spring of 1871, the land was three times ploughed, harrowed, and rolled to make its mechanical condition as favourable as possible. The field was subsequently divided into five equal parts, running from east to west, conforming with its slope. Each of these divisions received, a few days before seeding, five hundred pounds of various commercial phosphates, which were sown broadcast. The various kinds of seeds, which were imported during the last two years, had been previously tested in regard to their fitness for germination, and they all produced, after soaking a little in water, healthy young plants, within from seven to ten days. The following varieties and respective quantities were planted by means of Holbrook's seed drill, the most suitable implement on hand :—

1·5	pounds	of Vilmorin	of	1869.
7·0	„	Imperial	„	1869.
11·5	„	Imperial	„	1870.
10·5	„	Electoral	„	1870.
1·3	„	Vienne Globe	„	1869.
1·0	„	varieties of Mangolds	„	1870.

"The rows were two and one-half ($2\frac{1}{2}$) feet apart and passed from north to south through each of the fertilizers. The planting of the seed took place on the 11th and 12th of May, and on the 22nd of May, the rows were distinctly marked by the young crop. The entire field looked well, with the exception of first few rows on the east side, where some troubles with the "seed-drill" had left empty spaces.

"These spots were subsequently filled out with young plants from other parts of the field, at the time when the surplus plants were taken out; after thinning, the plants stood from six to eight inches apart. During the time, from the first of June until the twenty-first of July, the young plants were hoed three times, to keep the root-tops covered, and the space between the rows cultivated as many times with a horse-hoe to destroy the weeds. The whole crop looked promising during the entire season, with the exception of the transplanted beets, which remained behind in spite of an additional manuring, and confirmed the statement made in my previous report, that the general experience of beet sugar cultivators teaches, that it does not pay in most cases to transplant; for these plants remain usually so far behind, that they are of no value for sugar manufacture. Towards the end of September, the outer leaves began to dry up, indicating under normal circumstances the ripeness of the roots.

"My examinations concerning the saccharine properties of the various kinds of beet roots began at this time. The harvesting of the entire root crop took place on the 19th and 20th of October."

Dr. Gœssman's report on the qualities of the beets grown, is quite exhaustive, and is consequently of considerable length, and goes into minute particulars; the following is respecting the determination of the sugar in the juice :—

"Most of the sugar tests were made by means of an excellent Dubosq-Soleil's optical saccharometer. In some instances the results thus obtained have been verified after converting the entire amount of the cane sugar present into grape-sugar; in other cases, particularly where the Dubosq's apparatus gave high results, I verified the optical test by a chemical one by the use of Fehling's well-known solution. The juice for my experiments was produced, where not otherwise directly stated, in the following way: a number of sugar beet roots of various weights, which were collected from the five divisions of the beet field, were freed from the tops as far as the leaf marks extended. The roots were subsequently ground by hand upon a common tin grater and the pulp resulting pressed by hand in a strong cloth. In a few instances, when a larger number of roots were to be pressed for juice, they were cut by an ordinary root cutter, and pressed in a common iron screw press. The juice after being obtained in either of these ways, was either allowed to settle, or strained through a cloth, and then tested in regard to its specific gravity by means of a Brix's saccharometer. The preparation of the juice for the test with the polariscope was carried out in the following way: 500 c.c. of the juice were filled into a graduated glass-cylinder, and subsequently thoroughly mixed with 50 c.c. of a solution of sub-acetate of lead of the usual concentration.* As soon as a light colourless solution began to separate from the bulky precipitate, the whole mass was put upon two filters of coarse paper and quickly filtered. The juice thereby obtained was again without delay filtered through 150 c.c. of medium sized coarse bone-black. The first 100 c.c. of the filtrate were set aside and the subsequent filtrate turned to account for the optical test in the usual manner.

"I removed 100 c.c. of the filtrate, its first portion, for the purpose of rendering the solution for the tests independent of the incidental influence of bone-black (its moisture, &c.). This mode of proceeding was adopted to allow a direct comparison of my results with numerous other investigations of a similar character, and for similar ends. The polariscope was in each case adjusted with a carefully prepared standard solution † of pure sugar and also with water; the number of degrees required to produce the optical effect of presenting but one colour, were increased by one-tenth of their number to compensate for the dilution of the original genuine beet juice by the lead solution used for its defecation; each degree represented 0·1635 per cent. of sugar."

The condensed results of Dr. Gœssman's analysis are as follow:—

"* Digest 1 part of acetate of lead, 1 part of oxide of lead, and 20 parts of water at 30° to 40° C., from 6 to 10 hours, and filter."

"† 1000 c.c. water containing 163·50 grammes of pure sugar in solution, when filled into a tube of 200 m. m. length produces the same rotation as a quartz plate of one m. m. in thickness; 100 c.c. of water, containing 16·35 per cent. of pure sugar in solution, observed in a tube of 200 m.m. length, indicates the percentage by means of degrees."

SUGAR BEETS FROM THE COLLEGE FARM.

Date of Export.	Seed Imported in.	Kind of Beet.	Density of Juice.	Temperature.	Percentage of Sugar.	Foreign Matters in Solution.
1871, Sept. 10.	1870.	Electoral (Magdeburgh)	14 Brix.	17° C. (62·6° F.)	12·30	1·75
,, ,, 12.	1870.	Imperial	15 ,,	18° C. (64·4° F.)	12·59	2·41
,, ,, 13.	1870.	French Vilmorin, from Germany. .	14·5 ,,	18·5° C. (65·3° F.)	12·95	1·55
,, Oct. 11.	1870.	Imperial	15 ,,	22·5° C. (72·5° F.)	12·05	3·21
,, ,, 16.	1871.	Electoral	15 ,,	18° C. (64·4° F.)	12·22	2·95
,, ,, 18.	1870.	Vilmorin	16 ,,	16° C. (60·8° F.)	13·129	2·78
,, Nov. 14.	1870.	Imperial	15 ,,	18° C. (64·4° F.)	11·60	2·87
,, ,, 21.	1870.	Vilmorin	15·5 ,,	18° C. (64·4° F.)	13·12	3·34
FODDER BEETS RAISED IN COLLEGE FARM.						
September 19.		Vienna red, yellow, & white globe	11 Brix.	18·5° C. (65·3° F.)	8·004	3·0
,, 19.		Ordinary Mangolds	9 ,,	19° C. (66·2° F.)	5·035	3·97

The foregoing closely condensed table contains, as will be seen, the actual amount of sugar present in the juice; in the third part of Professor Gœssman's lecture, the actual amount of sugar extracted is given, together with its mode of extraction; and the conclusions to which the Professor comes, regarding the practicability, or otherwise, of the general growth of beet sugar in the northern parts of the United States.

(To be continued.)

THE SUGAR MANUFACTURE IN COCHIN CHINA.

The *Moniteur de la Reunion* contains an interesting letter from Saigon of the date of February 3rd, and thus introduces it to its readers. "Our young men who have not found employment here suited to their aptitudes and wants, should turn their attention to our beautiful infant colony, the development of which is progressing rapidly. There they might find a suitable opening for them, examples of success are not wanting, if we have some of the contrary. Whether or no, we intend to keep them informed of the situation, the progress, and colonization of Cochin China."

"'The great Kiesser Sugar enterprise has commenced working this season. The factory of Bien-Hoa alone can make 25 tons of sugar per day, suitable for sale in this country, it is a concrete centrifugaled, and as well as the molasses fetches good prices; but the exact return has not yet been made. A second factory of about the same size has been erected at La-can. In the single province of Bien-Hoa, 5,000 hectares (12,500 acres) are planted with canes. Some Chinese recently engaged have begun to clear the ground, and to plant it with canes for the factories. The inhabitants of your colony where the land may be exhausted, should follow this enterprise with great interest. What is very remarkable is that in the whole Kiesser undertaking there is not a man engaged who has directed, or is acquainted with a sugar factory.'"

ON THE INFLUENCE OF FORESTS ON RAINFALL.

By Alfred Fryer.

There are few among our sugar colonies, or the older sugar producing districts not under British rule, from which complaints are not heard of a gradually diminished rainfall, which affects the crops of sugar unfavourably. By some persons this change of climate is attributed to the destruction of forest, whilst others are unwilling to believe that so serious an affect can result from apparently so trivial a cause. The subject is, however, of deep interest, and indeed in some instances it may be considered of vital importance. Thus, sooner or later, the consideration of the question must force itself upon the notice of the Governments of those places which suffer the most severely from drought. In order to ascertain whether a correspondence exists between forest and rainfall, it may be proper to examine the opinions of the most eminent meteorologists and traders, British and foreign, and to note the recorded facts bearing upon the question. This enquiry will of necessity be a somewhat extended one, but the more complete it is made, the more reliable it will prove.

Dr. Home, Chairman of the Council of the Scottish Meteorological Society, has produced an exhaustive and valuable essay upon the water supply and climate of Malta, which will be found *in extenso* in the Journal of the Society. We make the following extracts:—

"In Malta at all seasons there is a scarcity of water, whereby health is affected, and the productiveness of the soil diminished. Great expense is incurred in the construction of tanks and reservoirs for the storage of water, which, moreover, if long kept, sometimes becomes unwholesome.

"Can anything be done to improve the climate of Malta? There is good reason for believing that, by forming extensive plantations on the island, such an improvement would result. At present the island is almost destitute of trees. There are a few carouba trees here and there, in the eastern districts, forming green spots, few and far between, which relieve the general monotony of the landscape, and which, in the hot and sultry months of summer, contrast pleasantly with the dry and burnt-up aspect of the surface. But on the uplands to the west of Citta Vecchia, on the Bingemma hills, and other high grounds in the western parts of the island, there are no trees of any kind whatever. In private gardens and shrubberies there are orange trees, oleander trees, cork trees, rhododendrons, and other shrubs—none of them, however, of any size.

"*Humboldt*, the distinguished philosopher and traveller, writes thus on the influence of trees:—

"'Trees act as refrigerators in three different ways: by shading the land from solar radiation, by transpiration from their leaves, and by the radiation of heat from their leaves. This three-fold action is of such importance, that a knowledge of the extent of forests, compared with the surface of the country which is uncovered, is a point of the greatest importance in judging of the climatology of a country. The want of forests increases both the heat and the dryness of the air; and this dryness, in diminishing the extent of vapour, and the vigour of vegetation, reacts on the heat of the climate.'

"*Boussingault* mentions a remarkable fact, which confirms the above statement. He says:

"'In hot countries, it is rare to be out in a cleared spot, when the night is favourable to radiation, without hearing drops of water falling continually from the surrounding trees. In our bivouac, between the 4th and 5th July, 1827, the night was magnificent. Nevertheless in the forest, which began at the distance of a few yards from our encampment, it rained abundantly. By the light of the unclouded moon, we could see the water running from the branches.'

"In like manner, *Strzelecki* says:

"'Terrestrial radiation in Van Diemen's Land, owing to the influence of vegetation, lowers the temperature of the ambient air in such a degree as to produce, whenever the atmosphere is clear, a copious condensation of the floating vapours, in the form of a shower, or in the form of dew, if no unfavourable circumstances intervene to prevent its deposition.'

"But, independently of a lowering of temperature in the air effected by trees, they are of use by the shade they give. For passengers, horses, or cattle travelling along highways, what more agreeable or desirable than a row of trees on the south side? and if they are on the field side of the fence, they are serviceable also to field labourers.

"It is well established, that when forests are destroyed, springs of water become more scanty; and that when forests have been encouraged to grow, water-springs are more abundant, and their flow more regular.

"In proof of this position, reference may be, in the first place, made to the opinions of several distinguished scientific men, who have specially investigated the subject.

" 'My opinion is, that the felling of forests over a large extent of country has always the effect of lessening the mean annual quantity of rain.'—*(Boussingault.)*

(*a.*) " 'Great clearings diminish the quantity of spring-water in a country.'

(*b.*) " 'It has not been ascertained whether this effect should be ascribed to a less quantity of rain which falls annually, or to a greater evaporation from the soil of rain water, or to a new distribution of showers of rain.'

(*c.*) " 'Forests, besides preserving springs of water, regulate their flow.'—(*Becquerel.*)

" 'The ocean, winds, and woods may be regarded as the several parts of a grand distillatory apparatus. The sea is the boiler, in which vapour is raised by the solar heat. The winds are the guiding tubes, which carry the vapour to the forests, where a lower temperature prevails. This naturally condenses the vapour; and showers of rain are thus distilled from the cloud masses, which float in the atmosphere, by the woods beneath them.'—(*Coultas.*)

"The opinions of many other eminent meteorologists might be quoted to the same effect,—such as *Herschell*, *Arago*, *Kaemetz*, *Lecoq*, *Clavé*, and *Tchihatcheff.*

"The British Association for the Advancement of Science, in the year 1851, appointed a committee to investigate this subject: and one of the conclusions to which this committee came, is thus expressed:

" 'That in a country, to which the maintenance of its water supplies is of extreme importance, the indiscriminate clearing of forests around the localities whence these supplies are derived, is greatly to be deprecated.'

"But as facts are better than opinions, the following cases may be mentioned:

"*Humboldt* was about the first who ascertained the effect of depriving a country of its native forests. He found that, in South America, the lake of Tacaragua, which has no outlet to the sea, had been constantly diminishing in size; insomuch that the town of New Valencia, which in the year 1559 was 1¼ mile distant from the lake, in the year 1800 was 3½ miles distant. *Humboldt*, whose attention was specially drawn to the subject by the inhabitants, after a careful examination of the locality, did not hesitate to ascribe the diminution of the waters of the lake to the numerous clearings which had been made in the district, especially during the previous half century.

"It so happened that twenty-five years after the date of *Humboldt's* examination, the same district was visited by *Boussingault.* For some years previously, the inhabitants had observed that the waters of the lake, instead of continuing to retire, were sensibly rising. Fields not long before devoted to the culture of cotton, bananas, and the sugar-cane, were being gradually submerged. This new aspect of things attracted the notice and excited the interest of the French philosopher. He ascertained that, during the time which had elapsed since *Humboldt's* inspection, cruel and bloody wars had prevailed in the district, almost exterminating the inhabitants. During that period the native forests, which in the tropics shoot up with wonderful rapidity, had grown, so as again to cover the country; and to their influence he at once ascribed the additional supply of water in the lake, fed by rills and rivers, traversing these forests."

(To be continued.)

THE PROSPECTS OF THE BEET CROPS ON THE CONTINENT OF EUROPE.

The unseasonable weather which prevailed during April and the greater part of May caused well-grounded fears, especially in France, that serious mischief would be done by the continued rain and hail with the frequent frosts, to the beet seed which had just been sown, and that at best the next season would be late by reason of the necessity of resowing; but the late change in the weather seems to be all that is needed to favour the young beets.

"Since the middle of last week," says the *Journal des Fabricants de Sucre,* "we have enjoyed dry and hot weather, which has been extraordinarily favourable to the beet root, and has dissipated all the fears which were entertained as to the future of this crop. The saccharine root only wanted heat, and this it needs no longer. The appearance of the beet fields is altogether changed, and thanks to the humidity which the soil preserves and which is shown in the night by abundant dews, even the youngest beets, sown late, are well grown.

"As we have said before, the sowing has been generally successful, and the lines are regular; the fields suffer most from weeds, the result of the continued wet, the beets themselves are now strong enough to resist the fly or other parasites, of which as yet we have heard very little."

In the other beet growing countries the aspect is favourable. In some parts of Germany the rains during the latter part of May, and the storms, were of a character to do great damage to agricultural produce, and parts of Bohemia suffered greatly from floods.

The extent of soil sown with beet this Spring is considerably greater than heretofore, and the estimate which M. Licht has already made of the probable yield of sugar in season 1872-73, based chiefly on the acreage and the present state of the young plants, is greatly in excess of that of any former season.

France	350,000	tons.
Germany, (Zollverein)	250,000	,,
Austro-Hungary	175,000	,,
Russia and Poland	135,000	,,
Belgium	80,000	,,
Holland and other countries	35,000	,,
	1,025,000	tons.

THE SUGAR INDUSTRY IN NATAL.

The cultivation of the cane is making remarkable progress in the colony of Natal. A correspondent resident there writes us: "A new and splendid factory has been established here, this year, the property of the 'Umgeni Sugar Company,' but as it is the second which has been erected upon one of our oldest plantations it must be regarded rather as the extension of an enterprise already undertaken than as the creation of a new concern. Many improvements have however been introduced, both in the old mills which are replaced by new machines, and also in the buildings which have given place to others of more convenient construction. At Redcliffe and at Ottawa vacuum pans are in full operation, and the sugar made upon any of the estates furnished with these valuable accessories will bear comparison with the finest samples of Mauritius. At Sunderland, the Concretor continues to work successfully and expeditiously. We are now generally convinced here (and we also notice it to be the case elsewhere) that the combination of the two systems—the Concretor and the vacuum pan, presents the *ne plus ultra* of sugar making."—*Journal des Fabricants de Sucre.*

METEOROLOGICAL OBSERVATIONS, noticing the pressure of the atmosphere, the temperature and humidity of the air, the fall of rain, the amount of ozone and cloud, the prevailing winds, and the variations in the weather, taken at Binfield, St. Joseph, Barbados, on the N. E. side of the Island, to windward, at an elevation of 1107 feet above the sea level.

YEAR AND MONTH.	Reading of Barometer, corrected for Height, and reduced to 32 degs.				Temperature of Air.							Dry and Wet Bulb.		Mean deduced dew point.	Mean degree of humidity.	Rain.		Ozone.		Wind.		Cloud.	
	Mean for month.	Highest in month.	Lowest in month.	Range.	Highest in month.	Lowest in month.	Range in month.	Mean of all highest.	Mean of all lowest.	Mean daily range.	Approximate mean for mo.	Mean of dry bulb.	Mean of wet bulb.			Number of days it fell.	Amount collected.	Mean at 6h, a.m.	Mean at 6h, p.m.	General directions.	Estimated strength.	a.m. 0—10.	p.m. 0—10.
1871.	in.	in.	in.	in.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.		in.						
January....	30·05	30·14	29·96	·18	79	65·5	13·5	77	68	9	72·3	73·3	71·0	69·3	89	27	5·00	..	..	E. by N.	0·5	6	6
February ..	30·11	30·26	30·00	·26	79	64·0	15·0	77	66	11	71·0	71·7	68·3	65·9	79	19	3·00	..	..	N.E.byE	0·4	7	7
March	30·09	30·26	30·00	·26	80	64·0	16·0	78	67	11	71·8	73·3	69·7	67·0	53	11	1·24	..	..	N.E.byE	0·4	7	7
April	30·09	30·15	29·95	·20	82	66·0	16·0	80	68	12	73·1	75·0	70·7	67·8	79	11	1·09	..	..	E. by N.	0·4	7	6
May	30·03	30·15	29·99	·16	84	67·0	17·0	81	70	11	73·8	76·3	72·0	69·0	53	13	0·91	..	..	E. by N.	0·5	7	7
June	30·11	30·17	30·07	·10	84	67·0	17·0	81	70	11	74·6	76·3	73·3	71·2	53	21	3·67	..	..	E. by N.	0·6	7	7
July	30·10	30·19	30·04	·15	84	67·0	17·0	81	70	11	74·5	76·7	73·7	71·6	53	21	4·34	..	..	N.E.byE	0·6	6	7
August * ..	30·03	30·10	29·92	·18	91	75·0	16·0	85	78	7	80·9	83·0	80·0	78·0	73	22	6·39	..	..	N.E.byE	0·5	7	7
September..	30·10	30·21	30·00	·21	84	69·0	15·0	82	70	12	75·2	76·0	74·0	73·0	51	18	8·71	..	..	E. by N.	0·5	7	7
October	30·07	30·16	29·99	·17	82	67·0	15·0	80	70	10	74·4	76·0	74·0	72·4	89	26	7·00	5	6	E. by N.	0·6	8	7
November ..	30·10	30·19	29·95	·24	84	66·0	18·0	80	70	10	74·7	76·3	73·0	71·1	82	21	3·81	6	4	N.E.byE	0·6	7	6
December ..	30·15	30·27	30·05	·22	79	66·0	13·0	78	68	10	73·0	74·0	71·0	69·4	80	19	5·11	7	5	N.E.byE	0·5	6	7
Mean	30·09	30·20	30·00	·20	82	67·0	15·0	80	70	10	74·1	75·6	72·5	70·5	70	229	50·27				0·5	7	7
ST. ANN'S GARRISON. —Mean ..	29·98	30·23	30·02	·21	89·6	71·2	18·4	87·4	73·6	13·8	80·5	83·4	74·9	69·3	62·5	20·4	35·15	6·3	4·	N.E.	3·2	4·9	5·1

* N.B.—The observations of the Barometer and Thermometer were taken during the month of August, at "Tenby," St, Joseph, at an elevation of 50 feet above the sea level; those of the rain and wind were taken at "Binfield." St. Ann's Garrison is on the S.W. side of the Island, to leeward, at an elevation of 28 feet above the sea level.

"Binfield," 1st March, 1872.

R. B. W.

A QUESTION IN SUGAR CHEMISTRY.

From the

"Zeitschrift fur Zuckurindustrie."

By E. Sostman.

1.—Analysis of Cane Sugar.

Analysis of cane sugar often shows this peculiarity, that the sum of the elements of it, pure sugar, glucose, water, and mineral substances is greater than 100. It is clear that this is only an error in analysis. Other chemists having made the same observation, the error cannot be attributed to the improper fixing of the polariscope, which is always tried first with pure sugar. Further, it may be remarked that in the analysis of the mineral matters no errors are made of sufficient importance to modify the result. The cause must then be sought in the analytical determination of the glucose and the water. The determination of the glucose is made on a principle in accord with a known standard of Fehling's solution, 10 c.c. of which correspond to 0·05 grm. of glucose prepared according to Fresenius (see *S. Analy. Quantit*) with a solution of a fixed weight of cane sugar in 100 c.c. of water. The operation was considered as finished when the blue colour of the solution had disappeared with about 90° or 100 c.c. But the results varying, it was common to weigh the precipitated sub-oxide of copper after its transformation into oxide, but this method is too tardy for practical chemists. It is then necessary to return to the method formerly recommended for the determination of glucose, consisting in the employment of a standard solution of ferricyanide of potassium. Neither the copper solution nor that of the ferricyanide being suitable for the determination of dark sugar or molasses, because of the impossibility of seeing when the reaction is complete in the coloured solutions, to effect this, subacetate of lead is added to the ferricyanide of potassium. A few drops of this salt of lead are sufficient, spread on a plate and reduced by the sugar solution under experiment, heating it with the ferricyanide, to make sure of the end of the reaction. So much of the ferricyanide of potassium as remains not decomposed in the solution is formed into a white precipitate of lead, whilst the least excess of glucose in the solution produces a deep yellow precipitate of ferricyanide of lead. The yellow precipitate becomes more easily recognised in molasses of a deeper colour.

Thanks to this aid, the determination of glucose by Gentele's method, the use of ferricyanide of potassium, is very rapid and very exact, and the results of the analysis of fine sugars agree sufficiently well with those obtained by Fehling's solution. But Fehling's method gives less exact results in the analysis of coloured sugars, whilst the standard liquor of ferricyanide of potassium employed in conjunction with the subacetate of lead gives precise results in sugars of all shades, so that this method of the determination of glucose may be specially recommended.

The following are some of the results of analysis :—

A solution was prepared of 0·95 grms of fine sugar, which had been inverted by hydrochloric acid. The liquid was cooled and the acid neutralised by carbonate of soda, and the solution raised to boiling point. Care being taken to keep it at boiling point, it was then thrown into a solution, previously heated, of ferricyanide of potassium in water, five times greater (10 c.c. corresponding to 0·05 grm. of glucose) until the drop of the mixture tested with the subacetate of lead on the plate forms a characteristic yellow precipitate.

ANALYSIS I.—0·95 gr. of cane sugar gave with the ferricyano-potassic method 0·985 gr. of glucose and with the copper solution valued by the weight of the oxide of copper, there was obtained 0·989 gr. of glucose.

ANALYSIS II.—0·95 gr. of cane sugar with the ferricyanide, gave 0·965 gr. of glucose, and with the copper solution 0·958 gr. of glucose.

ANALYSIS III.—0·95 gr. of cane sugar gave with ferricyanide 0·990 gr. of glucose, and with copper solution 0·977 gr. of glucose.

An experiment was also tried on some beet molasses of 46·2° on the polariscope. With the ferricyanide of potassium 47·71° of glucose were obtained, corresponding to 45·32° of cane sugar. By reason of the very dark colour of the solution of molasses, the polarization appeared to be in excess by 0·78°, because with the copper solution on weighing the oxide of copper 47·56° of glucose were shown corresponding to 45·18° of cane sugar.

(To be continued.)

Correspondence.

FRENCH AND ENGLISH CENTRAL SUGAR FACTORIES.

To the Editor of "The Sugar Cane."

Sir,

Numerous articles have appeared during the last few years in the Colonial newspapers, and some in the pages of *The Sugar Cane*, drawing attention to the success of many of the French Central Factories. The large profits which have been realised in some instances, and the establishment of new factories, together with the high prices at which the shares in such companies are usually quoted, have attracted the attention of planters in certain British colonies and of some capitalists at home. They naturally enquire, "Why may we not share in all this prosperity; capital is abundant in England, and the process of sugar-making is wretched enough to warrant the belief that improvement herein will be followed by large returns upon the capital to be invested in Central Factories. If we imitate the French we shall achieve similar success. The conditions being equal the results must also be equal."

Precisely so. All depends on this question, "Are the conditions equal?" *They are certainly not equal*, and it is to be presumed that a knowledge of this circumstance has hitherto prevented the erection of a Central Sugar Factory within any of the numerous British Sugar Colonies.

Let us examine one or two points of difference. The French factory sells white crystallized sugar, and pays for the canes a price based upon the colonial price of Muscovado sugar. It is manifest that the first consideration is to ascertain whether the relation which subsists between the prices of white crystals and Muscovado sugar in the French colonies is maintained in the English colonies. The price of sugars in the French colonies is regulated by the price of sugars in France, and in like manner the price of sugars in the British colonies is dependent upon the price of similar qualities in the English market.

While *usine* crystals enter France upon payment of an import duty of 27s. 4d. per cwt., the Muscovado sugar is charged with a duty of 25s. 6d. The Muscovado sugar all passes into the hands of the refiners, and its value to them depends upon the amount of sugar to be extracted from it. This amount can be determined with considerable accuracy. Experiments were made in Cologne in 1866 by the Belgian, French, Dutch, and British Governments. It then ascertained that average sugars equal in colour to No. 8 D.S. yielded 80 per cent. of refined sugar and average sugar equal in colour to No. 12 D.S. produced on refining 88 per cent. The standard Muscovado is about equal in colour to 10½ D.S., which would be equal to a yield of 85½ per cent. of sugar, provided Muscovado sugar were neither better nor worse than the average sugars with which the experiments were made. They were as follows:—

West India	14	per cent.
Mauritius	12	,,
Cuba	33	,,
Java	13	,,
Beet	28	,,
	100	

The West India Muscovado containing more moisture and glucose than most of the other qualities tended to bring down the average, and it is well known that such sugar will yield less refined than Java, Mauritius, or Havana sugar of similar type, and very much less than beet. Hence it would be proper to reduce the yield of West India sugar of 10½ D. S. from 85½ to 82½, but in order that no room shall be left for doubt as to the moderation of the estimate, we will take the yield at as high a figure as 84 per cent.

As already stated the Muscovado is charged with a duty of 25s. 6d., and it has been shown that the maximum yield is 84 per cent. It is now needful to calculate if 25s. 6d. is the appropriate rate of duty for 84 per cent., what is the appropriate duty for 100 per cent.? Answer, 30s. 4d. But the duty charged is only 27s. 4d., so that the white crystals are assessed with too low a rate of duty, amounting to 3s. per cwt.

But now we must consider whether the English colonist does not reap a similar advantage. It was arranged by the Convention of 1864 that the French and English duties should be adjusted by the same scale based upon the Cologne experiments, and if the French Colonial maker of crystals is protected to the extent of 3s. per cwt., the British colonist may secure equal privileges. These he would assuredly obtain if the English duties were equal to those of the French, but as our duties are only one-fifth in amount of those of the French, the English colonist can only gain 7d., or, the difference between a central factory making crystals and paying for the canes a price based on Muscovado Sugar, is 2s. 5d. per cwt. in favour of a factory in a French colony, over another in an English colony.

On a factory of moderate size this will be a bounty of £5,000, or near ten per cent. upon the capital invested.

Another fiscal question will also claim attention, namely, the effect of the *détaxe*. A discussion of this subject will be found in the pamphlet by J. B. Mariage, presented to the Committee of the

Sugar Manufacturers of France. This *détaxe* is a reduction of duty allowed upon French colonial sugars imported into France in French vessels. Mr. Mariage sums up thus: "In fact the *détaxe* of 5 francs alone represents 22 per cent. of the profits of the Central Factories or more than one-fifth!"

The Central factory system may be sound in itself, and prove successful upon English colonies, but it will be needful to separate the true success from the false, derived from bounties and protections; and it will be well to consider when these are withdrawn, and thus the premium on make of white crystals is withheld, in what method of manufacture real progress consists.

I am, Sir,

F.

Paris, June, 1872.

EXPENSES OF SUGAR CULTURE DURING SLAVERY.

London, June 12th, 1872.

To the Editor of "The Sugar Cane."

I lately found in my possession the accounts of the expenditure and the crops on four sugar estates in the island of Montserrat, from the year 1808 to 1812 inclusive; and again, for one year, at a period twenty years later.

They were furnished me by a friend, many years ago, then resident in the island, and I send them with his notes attached.

There is no reason whatever to suppose that these estates were other than a fair representation of the average position of sugar estates throughout the British West Indies, and I place them at your service, that they may help to dissipate a yet lingering superstition that the Emancipation Act was the ruin of our West India colonies.

An Account of the Expenditure and Crops on Four Sugar Estates, known as the A.W.K. estates, formerly the property of Mr. Willcock, and subsequently of Mr. G. S. Martin. They were always considered to be among the best provided and managed estates on the island. The books appear to have been carefully kept, and show all expenditure, &c. in detail; and the following is a carefully condensed statement of the only five years entire accounts, the rest having been destroyed.

From 31st July, 1808, to 1st August, 1812.

Description of Expenses.	Estates.											
	Webbs.			Brodericks.			Windward.			Tar River.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Food—Corn, Meal, Herrings, Codfish Rice, &c.	234	7	6	840	17	6	408	1	10½	397	6	9½
Hhds., Puncheons, Boards, Carpenters, &c.	364	1	2	625	10	9	517	17	2½	341	12	4½
Mill and Boiling-house Repairs, &c.	71	3	1½	221	17	8	207	3	8	118	12	9
Smith's work, Iron Nails, &c.	87	16	0	122	13	9½	95	5	0	61	10	9
Hired Task Gangs..	245	11	6	92	5	2	..		..	..		..
Mules and Horses..	..		..	401	2	3	44	8	9	88	17	8½
Sundries	31	6	2	51	2	0	..		..	15	9	5
Taxes	185	16	1½	411	3	0	310	18	4½	250	11	2½
Salaries	444	13	1½	714	9	10½	784	0	6	550	17	2
Invoices of Stores from England ..	551	10	10	1800	7	1	928	3	0	822	6	9
Medical Attendance.	55	2	0	120	11	7½	62	10	7½	61	8	9
	£2271	7	6½	£5402	0	8½	£3358	8	7	£2708	13	8
Hhds. of Sugar	..	139	..	..	251	..	..	268	..	..	176	
Puncheons of Rum..	..	98	..	..	156	..	..	190	..	..	152	
Cost per hhd. of Sugar	£16	10	0	£21	10	0	£12	10	0	£15	7	[illegible]

Slaves.

1808—Webbs	69	1812—Webbs	69
,, Brodericks	209	,, Brodericks	203
,, Windward	104	,, Windward	93
,, Tar River	106	,, Tar River	103
	488		468

Decrease in 4 years........ 20

Total No. of hhds. made, 834; average cost per hhd., £16 14s. 0d. —this is on the actual annual expenditure, *no charge for interest on slave or other capital invested.* All the molasses were made into rum. The accounts were kept in island currency, and converted into sterling at 225.

Even on these well and humanely conducted estates iron collars for negroes are among the smith's work.

Sugar appears estimated at a value of £50 per hhd.; rum sold for 2s. per gallon cash in the island.

Hired gangs of slaves charged 58s. 9d. for holing, and 29s. 4½d. for cross holing land for canes—the same work is now done for 18s. to 20s. and 9s. to 10s. by free men.

The invoices from England were large in those days, including clothing and some food for slaves, nails, hoes, bills, oats, beans, &c., &c.

Accounts for the same estates for One Year, from 31st July, 1831, to 1st August, 1832.

Description of Expenses.	Estates.											
	Webbs.			Windward.			Brodericks.			Tar River.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Food—Corn, Meal, Herrings, Cod fish Rice, &c.	58	8	10	35	0	0	121	15	6	63	9	9
Hhds., Puncheons, Boards, &c.	13	5	2	49	6	0	46	4	9	22	13	4
Mill and Boiling-house Repairs, &c.	36	18	6	32	6	0	23	11	9	27	5	10½
Smith's work, Masons Nails, &c ...	..		..	2	0	6	1	2	0	7	18	6
Hired Task Gangs..	207	0	10	..		..	..		..	..		..
Mules and Horses..	..		..	90	1	0	..		..	..		..
Sundries	2	11	0	1	18	0	4	1	0	2	1	0
Salaries	174	18	3	208	8	0	140	14	7½	151	2	10
Taxes	56	16	6	74	6	0	112	2	3	81	8	7½
Medical Attendance.	22	10	0	17	3	6	42	3	2	25	6	9
Invoices of English Stores..........	214	18	7	254	9	3	454	15	1	270	7	4
	£787	7	10	£764	18	3	£946	10	1½	£651	14	0
Hogsheads of Sugar	..	43	..	..	48	..	..	44	..	..	39	
Puncheons of Rum..	..	33	..	..	49	..	..	46	..	..	38	
Cost per hhd. of Sugar	£18	5	0	£15	18	6	£21	9	0	£17	7	0

The total No. of hhds. of sugar for the year, 174; average cost, £18 4s. 10½d.

It appears that the cost of a hogshead of sugar varied but little—probably the unsettled state of things in 1831 enhanced the cost, while it would appear that sugar was very low, being averaged at £13 6s. 9d. per hhd., and rum sold at 8d. per gallon.

I believe that it is generally admitted that the cost of sugar at present on well conducted estates varies from £8 to £10 per hhd. in the British West Indies.

The above estates were considered in those days to be of equal value to estates of similar production in St. Kitts, so that there is nothing peculiar in their case.

I think it may safely be said, that now as much sugar is made by one-half or two-thirds of the number of people it required during slavery.

It will be borne in mind that up to 1826, not only were West India sugars protected by a prohibitory duty against those of all foreign countries, but also by a high extra duty against those of Mauritius and British India—our own possessions. And further, at the latter portion of this period, the drawback allowed on the export of British refined sugar was considered by competent judges to enhance the price for home consumption to the extent of 5s. per cwt.

Of course an interest which had so long floated solely by the inflation of a system of such outrageous protection, at once collapsed at the touch of competition, with the produce even of our own dependencies, which had grown and extended in spite of their exclusion from the markets of the mother country. The admission of Mauritius sugars in 1826, and subsequently those from our East India possessions, brought the value of sugar in the British market to a normal condition, and (of course apart from the separate resources of the owners) left a vast proportion of West India estates in a hopelessly insolvent position.

If to the annual loss on the sugars produced, as shown in these accounts at the latter period of slavery, we added the accumulated interest on heavy mortgages, it will be seen that the Emancipation Act found the "West India interest" already a complete wreck, from which it was to a great extent rescued by the £20,000,000 compensation for losses, which protection and not emancipation had inflicted upon it.

I am, truly,

Edmund Sturge.

Nottingham, 3rd June, 1872.

To the Editor of "The Sugar Cane."

Sir,

In a foot-note on page 303 of your issue for June, mention is made of Du Rieux & Roettger's patent filter press, and as from the way it is referred to some of your readers might think they would have to go to France for this apparatus, may we be allowed to state, that we hold the *sole* right of manufacture for England and the English colonies; we are also able to supply these machines for other countries (not being French colonies).

We are, Sir,

Yours respectfully,

Manlove, Alliott & Co.

P.S.—The name of the latter patentee is Roettger, not Boettger as it was given in the pamphlet.

IMPORTS, STOCK, DISTRIBUTION, AND CONSUMPTION OF SUGAR IN THE FOUR PRINCIPAL PORTS OF THE UNITED STATES OF AMERICA, to June 1st, 1872, Compared with Five Previous Years.

From H. E. Loring & Co.'s Monthly Circular.

Imports to May 31st.	1872.	1871.	1870.	1869.	1868.	1867.	Average of Six Years.
	tons.	tons.	tons.	tons.	tons.	tons.	tons.
New York	184,577	167,490	142,035	171,880	143,886	100,068	151,656
Boston	41,979	34,004	34,315	26,789	31,046	23,358	32,415
Philadelphia	21,366	28,015	23,150	33,716	41,071	29,464	30,297
Baltimore	43,739	44,927	33,009	26,854	23,847	15,610	31,331
Total	294,661	274,436	237,509	259,239	239,850	168,500	245,699
Add Stock January 1st	62,795	56,497	80,956	43,547	25,118	55,490	54,067
Total Supply in 5 Months	357,456	330,933	318,465	302,786	264,968	223,990	299,766
Deduct Stock June 1st	108,227	108,443	125,740	122,012	61,195	73,588	99,867
Distribution in 5 Months	249,229	222,490	192,725	180,774	203,773	150,402	199,899
Less Exports ,,	1,260	763	2,669	1,762	1,053	877	1,397
Consumption ,,	247,969	221,727	190,056	179,012	202,720	149,525	198,502
,, Monthly average	49,594	44,345	38,011	35,802	40,544	29,905	39,700

MAURITIUS.

(From Licht's Monthly Circular.)

Exports from 1st August to 1st May.

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
To England	38,444	17,321	36,993
,, France	13,885	5,930	11,155
,, Australia	25,218	34,244	39,691
,, New Zealand	3,207	2,961	3,696
,, Bombay	23,187	15,953	28,496
,, Cape of Good Hope	965	1,859	1,587
,, Other Ports	5,375	643	1,109
Total	110,281	78,911	122,728

HAVANNA AND MATANZAS.

Exports from the 1st of January to the 4th of May.

	1872. Tons.	1871. Tons.	1870. Tons.
To United States of N. America	90,781	77,071	85,021
,, Great Britain	35,092	33,243	76,255
,, Spain	18,920	20,361	29,153
,, France	5,347	3,270	17,375
,, Northern Europe	5,069	1,699	6,426
,, Southern Europe	182	325	1,067
,, Other Countries	2,416	2,421	2,676
Total	157,807	138,390	217,974
Stocks in Havanna and Matanzas	124,112	129,438	165,650

Estimated Production of the present Beet-root Crop of Sugar compared with the two previous seasons.

(From Licht's Monthly Circular.)

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
France	330,000	289,083	289,324
Germany (Zollverein)	182,500	262,986	217,192
Austro-Hungary	162,500	182,280	151,354
Russia and Poland	90,000	135,000	132,500
Belgium	75,000	55,739	43,552
Holland and other countries	25,000	17,500	12,500
Total	865,000	942,589	846,422

Stocks of Sugar in the Chief Markets of the World on the 1st May, in thousands of tons, to the nearest thousand.

	1872.	1871.	1870.
Great Britain	81	114	119
France	59	108	129
Germany (Zollverein)	20	36	16
Holland	45	30	13
Six other Ports	3	6	4
Stock in Europe	208	294	281
United States of N. America	75	65	127
Havana and Matanzas	124	129	166
Total	407	488	574

Consumption of Sugar in Europe and the United States, for the Three Years ending 31st April, in thousands of tons.

	1872.	1871.	1870.
Great Britain	699	728	615
France	287	360	305
Germany (Zollverein)	202	214	214
Holland	24	27	28
Six other Countries	109	93	110
Total in Europe	1,322	1,372	1,272
United States	551	496	431
Total	1,873	1,868	1,703

SUGAR STATISTICS—GREAT BRITAIN.

To 15th June, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	7	1	1	12	22	40	26	4	6	22	58	83	30	3	6	19	59	68
British East India	3	1	..	..	4	7	5	3	..	..	8	4	6	5	..	..	11	13
Mauritius	3	1	1	..	5	3	9	3	11	6	29	10	9	3	11	8	31	10
Cuba	1	1	1	8	12	16	..	3	8	14	26	28	3	2	7	11	24	24
Porto Rico, &c. ..	..	3	..	2	6	7	..	6	..	2	8	11	1	5	..	1	6	11
Manilla & Java ..	10	5	..	..	15	32	13	8	2	7	29	26	15	12	2	8	37	34
Brazil	3	10	1	7	20	16	5	25	6	11	50	32	3	24	5	13	44	32
Beetroot, &c.	4	..	..	..	4	15	12	8	4	31	54	82	14	10	5	36	64	82
Total, 1872 ..	31	22	5	29	87	138	70	60	36	97	263	276	80	64	36	96	276	273
Total, 1870 ..	64	32	7	35	51 decrease		87	56	29	104	13 decrease		93	57	27	96	3 increase	

STATE AND PROSPECTS OF THE SUGAR MARKET.

The firmness and activity which prevailed a month ago has been succeeded by considerable dullness, and although there appears to be no valid reason for decline in value, yet prices of some descriptions of sugar have given way slightly. No. 12 Havana afloat for the United Kingdom, is quoted at 31s. per cwt., the same as last month; and in Cuba Muscovados, in Bahias and Pernambucos, there is no appreciable alteration. Sales however have not been pressed, or it would have been needful to submit to some concession to do business to any large amount.

The average duty paid price of British Plantation sugar is now 32s. 6d. per cwt., an apparent decline of 6d. per cwt. Crystallized Demeraras are fetching high prices, 42s. per cwt. duty paid, has lately been given. In refined goods the market has been quiet, with but slight variations in prices.

Imports of raw sugar at the Four Ports, from 1st January up to the 15th June, show a decrease of 12,000 tons; in beet sugar alone the decrease is 28,000 tons, and in British West India 24,000 tons; the imports from Cuba and Porto Rico are rather below those of last year, and from the British East Indies rather above; whilst from Brazil there is an increase of 18,000 tons, and from Mauritius of about the same amount. Stocks continue to decrease, being now 51,000 tons below those of last year at this date. Deliveries have decreased during the month, and for the six months are only about 3,000 tons more than in 1871.

The prospects of the next beet crop on the Continent of Europe are more favourable than a month ago, and the estimate of the production of beet sugar for the season 1872-73 is 150,000 tons above the yield of last season, consequently, prices for forward delivery have declined to some extent. Latest accounts from Cuba unite in stating that the present crop will prove to be considerably in excess of last—probably from 15 to 20 per cent.—but with this addition, the crop will, it must be remembered, still be considerably deficient as compared with the years 1870 and 1869

THE

SUGAR CANE.

No. 37. AUGUST 1, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

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THE INTERNATIONAL SUGAR QUESTION.

On the 21st of June a deputation of British Sugar Refiners consisting of Mr. Duncan, of London, Mr. Barrow, of Liverpool, Mr. Hale, of Bristol, and Mr. Fryer, of Manchester, gave evidence before the Superior Council of Commerce of France, in Paris, on behalf of the British Refining interest. In addition to this evidence which was very voluminous, an exhaustive reply was returned by the Deputation to such portions of the *Questionaire* submitted by the Council as affected the British Refiners. This reply, would but for want of space have appeared in full in this number of *the Sugar Cane*, but at present the following extracts only can be given :—

"Each class of necessity comprises various qualities of sugar. If sugar refining were conducted in bond, all the sugars comprised in any class would be purchased for refining for export without any preference, as their normal values would not be affected by fiscal considerations ; and if the yield of the average sugars comprised in each class were then determined, the answer sought would be ascertained. But as the values of sugars are altered by the present mode of assessing the duties, the sugars selected in France for refining for export do not represent the average quality of any class. In order to obtain the greatest amount of drawback, the finest sugars of each class are selected; and in France, where the duties are very high, a strong inducement is offered to purchase the finest sugars in each class. In like manner, a strong inducement is offered to select indigenous sugars for this purpose, as they contain more pure sugar than is present in exotic sugars of similar colour.

"The duties and drawbacks are calculated upon the Cologne experiments, and it will be conceded that the art of sugar refining has at least not deteriorated since these were made. In conducting the experiments, the various sugars comprised in each class were mixed together and submitted to the process of refining, the product obtained was therefore the yield of the average sugar in each class. The sugars of Nos. 7, 8, and 9, D.S., yielded 80 per cent. of refined. The sugar of No. 7 would, if refined separately have yielded less than 80 per cent., and that of No. 9 would have yielded more, whilst No. 8 would be the quality of sugar that would most nearly have yielded 80 per cent. In like manner, Nos. 10, 11, 12, 13, and 14 yielded 88 per cent., which would manifestly be the yield of a sugar very close upon No. 12. Nos. 15, 16, 17, and 18 yield 94 per cent., which would be the correct yield for sugars about 16½ D.S. If, then, we take these figures and interpolate the yields of the intermediate Dutch numbers, we shall obtain the following table :—

D.N., No. 8	..	By Experiment	..	80 per cent. yield.
9	..	,, Calculation	..	82·2 ,, ,,
10	..	,, do.	..	84·5 ,, ,,
11	..	,, do.	..	86·4 ,, ,,
12	..	,, Experiment	..	88 ,, ,,
13	..	,, Calculation	..	89·6 ,, ,,
14	..	,, do.	..	90·2 ,, ,,
15	..	,, do.	..	91·8 ,, ,,
16	..	,, do.	..	93·3 ,, ,,
16½	..	,, Experiment	..	94 ,, ,,

"The refiner who purchases sugar of No. 9, if able to obtain no higher return than that in the experimental refinery at Cologne, will thus secure a bounty on export of 2·2 per cent.

"But in 1870 the standards of beet sugar were altered, and the standard marking the upper boundary of the third class is now $12\frac{3}{4}$, D.S., so that the refiner may use sugar from which he will obtain 89 per cent., being an excess of 9 upon 80, or about 11·3 per cent.

"Beet sugar is richer in saccharine yield than average cane sugar of similar colour, and as the Cologne experiments for this class contained only 28 per cent. of beetroot and 78 of exotic sugar, it follows that the refiner of beet alone will obtain a bounty equal to the duty on $\frac{78}{100}$ of the difference between the yield of beet and cane sugar.

"These various bounties in the case of countries with high duties are very large and tend to make the art of sugar manufacture in France degenerate into the art of escaping duty, and to reduce the sugar beet industry to the art of producing sugar so degraded that its appearance belies its saccharine quality.

"It is not easy for English refiners to state the precise money value of the bounties obtained by the French refiners unless they solve the problem as it is presented to-day in France by the method which the parties to the Convention adopted at Cologne, and by which the French Government determined the yield of sugar Concrete at Havre, that is to say, by the employment of a sugar refinery in France and by working it under the inspection of the French Government.

"The French refiners are compelled to share a portion of the bounty with the producers of the sugars best fitted by reason of their low colour and high saccharine quality to escape the duty. Thus we find the anomaly that sugars of low colour are sold in France at prices higher than those of better colour. Thus sugars of 88° standard are now sold when only equal in colour to 7 or 9 at 80 francs, whereas sugars of superior colour, namely, 10 to 13 D.S. are only worth 75 francs per 100 kilos.

"But it has been said that if the French refiners obtain an advantage at one portion of the scale and the upper end of each class—their gains substantially disappear, inasmuch as these refiners are compelled to take all the sugars that are presented, not only those from which they can gain, but also those from which they cannot gain,—and the one compensates for the other. This argument, however, cannot be admitted. The French refiners anxious to secure the sugars by which they can escape duty, compete for such and raise their price. On the other hand, they neglect such as least enable them to attain this object and the price of these falls. The *Fabricants*, tempted by the high price of the former sugars, conduct their process of manufacture in such manner as to produce the favoured sugars in the greatest abundance, and discouraged by the lower price of the latter, avoid the production of them to a large extent.

"Thus the market is mainly supplied with sugars which are the most profitable for the refiner to use, and if the present vicious system be not arrested, the skill of the *Fabricants* will perfect the art of producing only those sugars that will most injure the French Treasury.

"But the quantity of beet sugar produced in France is largely in excess of the requirements of French consumption, together with the export trade of French refined sugar. Hence there is an inevitable efflux of raw beet sugar, and as those qualites which are least fitted for securing a high bounty have not been raised in price as previously explained, and are rejected by the French refiners, they must be exported. If it be objected that the English refiners to whom the sugars are sold would be as certain to select the favoured sugars as their French competitors inasmuch as the duties are in effect laid on the same principle, the reply would be,—that such could only be the case if the duties were equal in the two countries. But as the French duty is about five times in amount that of the English, the French refiner receives out of the French Treasury a sum of money five times as great as the English refiner could obtain, and with this sum he can afford to pay a price for the favoured raw sugars that will drive the Englishman away.

"Thus it is apparent that the French refiner can secure the favoured sugars, and those by which he could obtain the least bounty will be exported.

"At the same time it is apparent that the refiners do not secure all the bounty obtained from the Treasury, but are compelled to share it with the *Fabricants.*

"Yet the bounty is so great that even the portion retained by the refiners is sufficient to enable them to sell the loaves in London, though this involves the high charges incident thereto, amounting to about 1s. 9d. per cwt."

Note.—The Superior Council has since reported in favour of Refining in Bond by 13 to 5 votes.—Ed. *S. C.*

A QUESTION IN SUGAR CHEMISTRY.

From the

"Zeitschrift fur Zuckurindustrie."

By E. Sostmann.

(Concluded from page 380.)

The determination of the water in the analysis of sugar has often been the means of giving an inexact result, which we explain by the too great heat, (100° to 110° C. (212° to 230° Faht.) for beet sugar) applied to cane sugar, shown by the dessicated samples being generally more or less browned according to their quality.

For this reason we have dried different samples for comparison at 100° and 50° C. (212° and 122° Faht.) The dessication at 50° C. was made in a tube, one part of which communicated with an exhauster, and another with a vessel filled with concentrated sulphuric acid. In this way a light current of air dried by the sulphuric acid, passed over the sugar under analysis at a constant temperature of 50° Cent. This dessication requires, it is true, six or eight hours longer than that made at 100° Cent., but the results are so much the more satisfactory. Beyond twelve to forty-eight hours dessication no diminution of weight could be distinguished.

Experiments in Dessication.

	I.	II.	III.	IV.
Dessication at 100° C. (212° Faht.)	3·42	4·35	3·97	4·21
,, 50° C. (122° Faht.)	2·97	3·64	3·40	4·04

We give below some complete analyses of cane sugar—

	I.	II.	III.	IV.
A. Cane sugar as shown by polariscope, including 0·34 per cent. for each proportionate per cent. of glucose	90·80	91·20	90·60	90·80
Glucose determined by copper solution	3·85	3·49	3·84	—
,, ,, Ferricy. potass.	—	3·70	3·96	3·81
Mineral salts—carbonates	—	1·07	1·09	—
Water determined at 100° Cent.	3·42	4·35	3·97	4·21
,, ,, 50° Cent.	2·97	3·64	3·40	4·04

The analyses II. and III. then show in sucrose, glucose (determined by ferricyanide of potassium), mineral salts, and water (determined at 100):

II.. 100·32 .. .. Difference = + 0·32
III.. 99·62 .. .. ,, = — 0·38

On the other side, if the amount of water is determined at a temperature of 50° Cent. (122° Faht.)

II.. 99·61 .. Difference = — 0·39 organic matters.
III.. 99·05 .. ,, = — 0·95 ,,

The following analyses will also serve to compare the two methods—

	I.	II.
B. Cane sugar by the polariscope	90·00	89·40
Glucose determined by Fehling's solution	3·70	4·57
,, ,, ferricyanide of potassium	3·80	4·58

In other analyses of good Java sugar there were obtained cane sugar, glucose (with Fehling's solution), water (determined at boiling point), and a centesimal portion of carbonates =

100·64
100·14
100·21

So that, not only was there nothing left for organic matters, but even the number 100 was passed.

It seems then that the error in the methods of the analysis of sugar should be sought for in the determination of the water, and that it might be avoided by submitting the sample to a longer and more complete dessication at a temperature of 50° Cent. (122° Faht.) But the determination of the sucrose in coloured sugars by *Gentéle's* method (the employment of ferricyanide of potassium with an indicating reagent such as sub-acetate of lead) should be considered as more sure and precise than the use of Fehling's solution and as giving nearly the same results as by weighing the oxide of copper.

Researches on the Alterability of Concentrated Solutions of of Sugar, heated with Lime.

As latterly the opinion has seemed to prevail that concentrated solutions of sugar are rapidly modified by boiling with lime, a series of experiments were undertaken with the object of studying this property of saccharine juice. With this end in view dense juice which had been heated with an excess of lime at various temperatures and during variable intervals of time, was obtained from the factory. The juice was examined before and after boiling with Dubosq's polariscope, the scale of which is divided into 150 degrees for right handed solutions; 16·35 grms. of pure sugar in these solutions corresponding to 100 degrees, the tenth of which may be ascertained. The colour is perfectly distinguishable to two tenths of a degree.

I.—Concentrated Juice.

Density..............	1·1021 (about 13½° Baumé)
Degree Brix..........	23·08
Sugar	20·02

Before the operation 50 cubic centimetres of this juice weighed 55·106 grms. After the addition of milk of lime the mixture was boiled for half-an-hour in an oil bath in a small vessel of 100 c. c. At the commencement the temperature was 105° C. (221° Faht.), then carried to 113° C. (235° Faht.) After boiling half-an-hour the vessel with the solution was cooled quickly, and then the solution was neutralized by acetic acid, and purified for the polariscope. When the solution was diluted to 100 c.c. it polarized exactly the same as before, but when not diluted=61·2.

II.—Solution of Concentrated Juice.

Density .... 1·2015 (about 24° Baumé)
Degree Brix ....44·28
Sugar ....41·20

This solution was previously decomposed by milk of lime; the degree of alkalinity obtained by the standard and calculated as the alkalinity of lime, was 0·185 per cent.

(a). 50 cubic centimetres of this solution=60·0746 grms. diluted to 100 c.c. after purification polarized 151·2=41·20 grms. of sugar in 100 parts of the solution.

(b). 50 cubic centimetres of the concentrated juice (II. trial) heated for half-an-hour in an oil bath at 113° C. (235° Faht.) cooled, and neutralized with acetic acid, purified and diluted to 100 c.c.; polarized 151°.

(c). 50 cubic centimetres of solution II. heated in the oil bath for half-an-hour to 103° C. (217° Faht.), (the thermometer plunged in the juice) showed 150° on the polariscope.

(d). 50 cubic centimetres of solution II. heated in a sand bath and diluted as above to 100 cubic centimetres, polarized 151°.

(e). 50 cubic centimetres of solution II. were heated for three hours in an oil bath up to concentration. The temperature at the commencement 102° C. (216° Faht.) was shown by the thermometer plunged in the juice, towards the end, that is to say after three hours, at 107° (225° Faht.).

The concentrated juice dissolved in water, &c., and treated as above, showed 151·1 on the polariscope.

These trials show that the boiling of beet juice with lime does not influence as much as 0·2 per cent. of the sugar it contains, if the solution is reduced to a thick *masse,* concentrated at a temperature of 107° C. (225° Faht.). This peculiarity of sugar in the presence of lime is that the same as of the property formerly studied of not becoming modified in presence of alkalis at a temperature of 100° C. (212° Faht.)

If it is needful to produce further evidence against this alterability, the following experiments will supply the latest discovered action of the lime.

Two samples of juice of 50 cubic centimetres each, in the same condition as above, were evaporated to dryness in a steam bath, one of the liquids, *a* immediately, the other *b* after having been previously heated over a spirit lamp for half-an-hour. The two dried residues were placed in glass vessels and exposed to humid air.

The residue *a* was observed rapidly to absorb the humidity of the air and become a fluid *masse*, while the residue *b* preserved its state of dryness after a fortnight's exposure to the damp air.

The natural conclusion of these experiments is to show how the lime acts in the presence of beet juice at the boiling point; conditions in which a part of the organic principles of the juice are modified at the risk of losing their hygroscopic property. The property of a saccharine *masse* to absorb vapour from humid air, should with reason be considered as a cause of the production of molasses, and the boiling of the juice immediately after saturation cannot on this account be too highly recommended.

III.—DETERMINATION OF SUGAR IN THE ANIMAL CHARCOAL EMPLOYED.

The quantity of sugar retained in the filters by the animal charcoal is notwithstanding the most careful washing, still so considerable that it is quite indispensable that a remedy should be found for this inconvenience in the fabrication.

The losses due to animal charcoal are of two kinds. 1st. That produced by the water remaining in the filters and which is generally left to run away after the washing is finished. 2nd. The loss occasioned by the animal charcoal itself.

It is easy to ascertain the loss of the sugar produced by the running away of the water. It is sufficient to know the quantity of water left in it, then to evaporate to dryness about 100 cubic centimetres from each filter, adding to it a little lime and making the dry residue obtained after a week's dessication into a solution, raising it to 212° Faht., then finding its polariscopical degree, which is to be calculated on the total quantity of dry matters to be obtained from each of the filters in use.

The estimation of sugar in the charcoal is however more difficult because it is nearly impossible to remove with pure hot water all the sugar contained in the charcoal. For some years I have employed the following process for the determination of the sugar contained in the charcoal. I take some from each filter, from each of which I rapidly dry a sample of 50 or 100 grs. in a drying apparatus. At the end of the week I weigh the dried charcoal and scald it in a tall metal cylinder, adding to it then a little sodic-alkaline water (10 cubic centimetres of alkaline solution of a density of 1·33 for about 1000 grs. of dry charcoal.) The liquid is allowed to flow through slowly by means of a small tap at the bottom of the cylinder and it is evaporated in a water bath, care being taken to add a little lime. At last the charcoal is twice washed with hot water and again placed in the drying apparatus. The addition of lime during the operation is recommended merely because the soda absorbs a certain quantity of colouring matter from the charcoal, which without the addition of lime produces a thick solution difficult to analyze by the polariscope after the clarification by acetate of lead. Then the addition of a suitable quantity of lime during the concentration precipitates part of the colouring matters.

The solution sufficiently concentrated is (after cooling in a small vessel) clarified by acetate of lead, raised to 212° Faht., and submitted to polarization. The quantity of sugar thus found corresponds to the totality of the charcoal washed, and it is only neccessary to calculate the percentage.

The possibility of extracting integrally the sugar from the charcoal in this manner has also been demonstrated by a direct experiment with pure sugar. 1000 grammes of char were treated for twenty-four hours with water in which 1 gr. of sugar was dissolved. The process was followed as above by a washing of soda. The result of the operation gave 0·98 of sugar by the polariscope.

IV.—Determination of Sugar in Beet Slices and Pressed Masses.

The different methods of the quantative analysis of the sugar in sliced beets or pressed masses, &c., have the inconvenience of having to deal with great quantities of liquid. Because the slightest error committed in an analysis of 100 c.c. for example will be multiplied 4, 5, or a greater number of times accordingly as the solution operated on is one of 400, 500 or more. This is especially the case in the analysis of the sugar in the sliced beets, which require, because of their great volume, a very large proportion of water to keep them constantly immersed. This difficulty has caused the trial of another process for estimation of the loss of sugar in the slices. To remedy the losses occurring weekly it has been suggested to take a sample of slices from each diffuser, of which 100 grammes are submitted to a rapid dessication (as formerly recommended by Dr. Scheibler); nothing is now more easy than to extract the sugar from the dry mass, by alcohol. For this purpose the slices are reduced to a fine powder, then passed through a sieve; 200 grammes of this fine powder are diluted with a certain quantity of alcohol in a gauged measure, and after taking the gross weight of the whole it is allowed to remain for two hours in the evaporating apparatus. Afterwards, with a very finely balanced scale the weight of the alcohol evaporated is determined, then ahout 105 cubic centimetres of this solution are passed by a pippette into a flask. After cooling, 100 c.c. are measured and evaporated; the dry residue dissolved in water is clarified, if needful, and examined by the polariscope. To be more sure, the saccharine solution is inverted to determine the quantity of glucose. By this method exact results are obtained, and we thus succeed in obtaining in alcoholic solution, an equivalent of the sugar retained in the slices.

To make sure of the solubility of the sugar in the slices washed in alcohol we have submitted 200 grs. of the dry powdered slices to a washing in heated alcohol; these different solutions evaporated and treated as above, have given sufficiently concordant results, whilst the slices collected and treated with diluted hydrochloric acid have not shown a single trace of glucose.

TRINIDAD.

Thomson's Road Steamer.—We learn from the best source that the steamer at work now for several weeks on Mr. Brunton's Estate, in Diego Martin, is a perfect success. It has never given any trouble; the rubber tires are in perfect order; it runs over the common road and traces without requiring any special precaution. The dry gutters are filled with cane, in the usual way as for carts, to allow it to pass, and not one of these canes, even if young cane, is bruised. Mr. B. says, he believes he may put his arm under the wheel without danger. Only three great cane trucks were built for the engine to draw, but it runs off with them with such ease, the proprietor is confident it could draw another with facility. The three trucks in use are equal to 24 cart loads, and carry a quantity of cane that yields 3000 gallons of liquor. With this load it runs with the greatest freedom, even up inclines. An engine-man and stoker are all the labour and guidance it requires. Mr. B. says it has proved a great economy, even in this, its first year of use. It makes him able to dispense with many cartmen and much draught stock. We were wrongly informed in saying some months ago that the engine was put together by an engine-wright sent out by the factory. It was fitted and has been since worked by a creole engine-wright.

Mr. Kernahan's Rochester engine went through the streets delighting the townspeople yesterday, with the sight of a train of sugar hhds. (six) drawn through the streets by steam-power. This was its first working trip, we believe. It was repeated this morning. The train went at good speed. Trinidad is waking up.—*Chronicle*, 21st May.

Sugar Refining.—One of the largest copper vacuum pans ever made was shipped from Greenock for Liverpool, a few weeks since. The dimensions are—12½ ft. diameter and 13 ft. depth. It is capable of boiling, at one "skippen," 27 tons of moist sugar in 2½ hours, and has cost, with appurtenances, £2,800. Messrs. Adam were the makers, and they have four similar pans in course of construction—two being for Bristol, one for Leith, and one for Greenock.

ON THE ROTATION OF CROPS ON A SUGAR ESTATE, WHERE FIRST RATOONS ONLY ARE PRODUCED.*

By Spencer Hollings.

The accompanying diagram (opposite page 408) is supposed to represent an estate of one hundred acres of arable land; but, for convenience in sub-dividing, only ninety-nine acres are recognised as available; the other acre may be considered as laid down in permanent guinea-grass,—as kept for experiments in manures, or any other purpose.

On estates where the practice is to ratoon but once, it is usual to plant one-third of the land, ratoon one-third, and keep one-third for the next ensuing crop; this last portion is usually allowed to lie fallow till wanted, but it has been found that the land becomes so baked by the sun, that it is almost impossible to plough it; and when the time arrives for planting, from its extreme dryness, the difficulty of getting an even growth is great, since many of the plants die.

It has been the custom for many years in St. Kitts, and some others of the Leeward Islands, to avoid this fallowing, by putting the land in green crops, which are ploughed in when they have arrived at their greatest perfection; these have the double effect of shading the earth from the scorching rays of the sun, and of producing an abundant supply of the finest manure on the very spot where it is wanted. Land so treated has been found to increase in fertility every successive crop, and many so-called "worn out estates" have been rendered highly productive by this means. A still better result may be obtained by varying the green dressings, as, for instance, planting pigeon peas for one crop; for the next, Bengal beans; and occasionally alternating with a thorough farm-yard manuring.

In order still further to avoid the damage done to the soil by exposure to the sun, in cases where shortness of time or lateness of season renders pigeon peas or Bengal beans undesirable, potato or yam crops may be grown—the former taking only three and a half to four months to ripen, and growing well at any season of the year;—the latter requiring eight months, and the best season for planting being either May or June.

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* The writer of the article does not intend to assert that any estate can be worked with the regularity of the diagram, as dry years or other disturbing causes may interfere; but in all things there should be a recognised system, and he believes sugar planting to be no exception to this rule, and that the nearer we can approach to some perfect system the better.

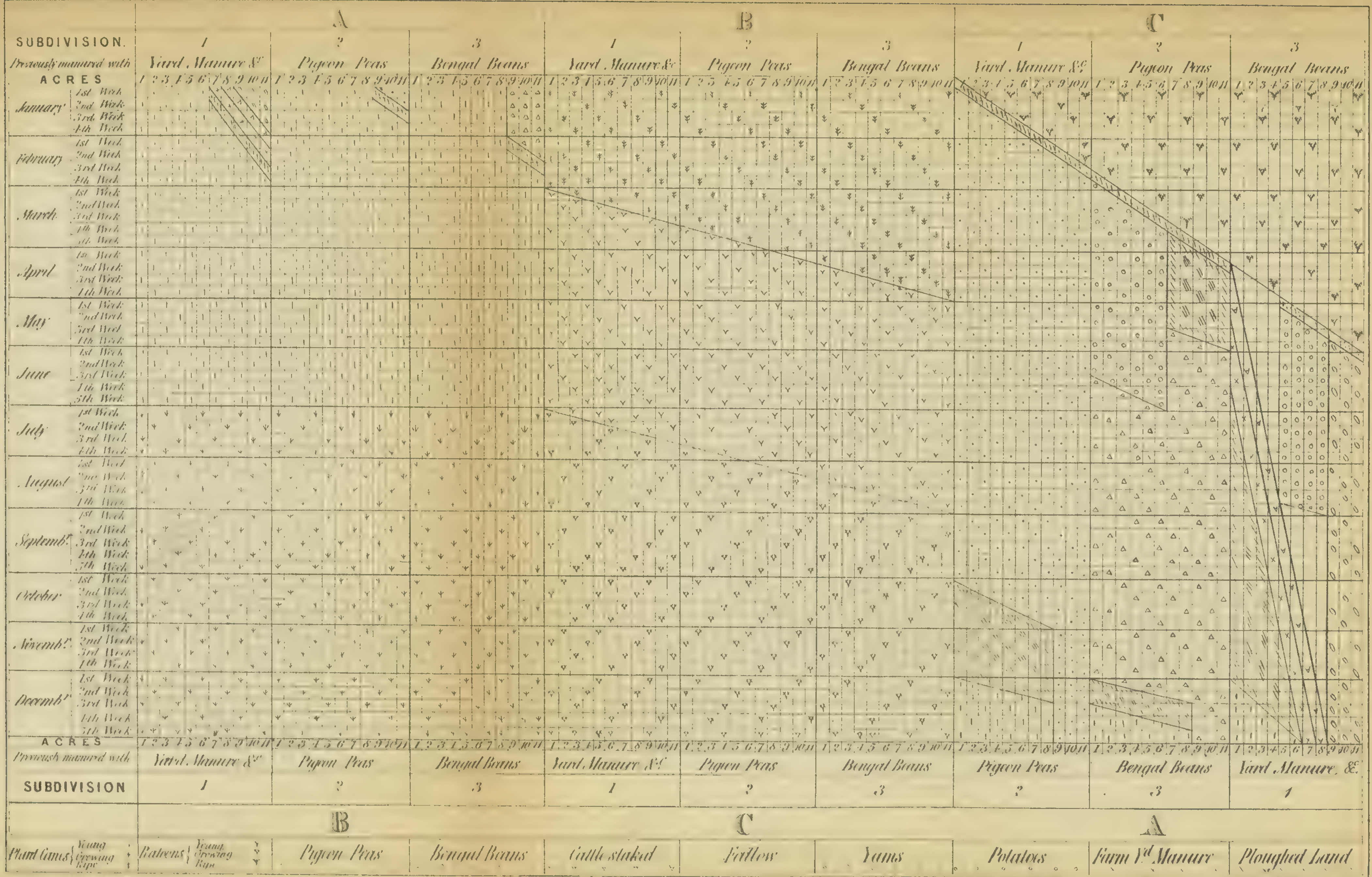
It is only necessary to see an estate that has been worked for a few years on this plan, to be convinced of the soundness of the method, which is the system the diagram is founded on. Some explanation of the mode of working may not be out of place:—

For convenience of exemplification, the ninety-nine acres are represented by the ninety-nine spaces on the diagram, running from left to right, and are distributed into three sections of thirty-three acres each, to represent the three crops always on an estate in the month of January, viz., the young plant sprouts, the old plant canes, and the first crop of ratoons; and each section is again divided into three sub-divisions of eleven acres each, to shew the rotation of the manure crops. Thus a cycle of nine years is comprised, the tenth bringing back a recurrence of the same crop conditions as existed in the first.

The fifty-two cross spaces running from the top to the bottom of the diagram represent the weeks in the year, and the larger divisions the months.

Thus, on January 1st, at the beginning of the cycle, there are, according to the diagram, six acres of young plant canes previously manured with farm-yard manure, one acre in process of manuring, and being rapidly ploughed in; one acre in process of cattle stakes; three acres in yams; eight acres in young plant canes, previously manured with pigeon peas; and three acres pigeon peas left for seed, now ripe, and being ploughed in; eight acres of young plant canes, previously manured with Bengal beans; three acres of Bengal beans left for seed;—these are in Section A, and form the thirty-three acres for the young crop. Section B consists of thirty-three acres of old plant canes, eleven being previously manured with yard manure, eleven with pigeon peas, and eleven with Bengal beans, forming the crop now nearly ready for manufacture and subsequent ratooning. Section C consists of thirty-three acres of ratoons, manured in a similar manner, which occupy the land to be manured and planted for the next ensuing crop of young canes.

These general conditions hold good for January 1st in any one year of the whole cycle, the young crop being always found under section A, the old plant canes under B, and the ratoon crop, for subsequent manuring, under C; but should we desire to trace the young crop through its various stages of growth, cutting, ratooning, manuring, and replanting, we take section A only (as it represents the young plant crop), and we find that the whole thirty-three acres are planted by the last week in February; on reaching the end of the year we are directed to section B, following this down, we find the plant canes are cut off in the course of March and April, and immediately ratooned, arriving at the fifth week in December, we are referred to section C, and find that the ratoons are cut during the months of January, February, March, April, and May; that the land is immediately ploughed, that portion cut in January and part of February, is put in pigeon peas; that cut early in March, as it is too early to plant Bengal beans, is planted in potatoes, to be afterwards put in Bengals; on that cut in April the cattle are at once staked, and it is further enriched by farm-yard manure, the plough following close on these operations to cover all in; of that portion cut in May, part is put in potatoes, and part in yams, as it will probably have eight months before the cattle stakes reach it. In October the pigeon peas, now at their greatest perfection, are ploughed in (leaving a portion for seed); in December this ploughed land is planted in canes, and the Bengal beans are ploughed in (likewise leaving a portion for seed), and planted; that part of the land which was manured and ploughed is also planted. In January of the fourth year we come back to the condition of things that existed in the first year of the cycle, inasmuch as the same fields are in young canes, the same in old, and the same in ratoons—*but the previous manuring has not been the same.* In order to trace this we refer to the sub-divisions and start on the *nine years' cycle.* In doing this, the lower set of sub-division numbers is to be employed to connect the year terminating at the foot of the vertical columns, beneath



THE SUGAR CANE [illegible] J. Roberts, Printer, Salford which they are placed, with the head of the columns similarly numbered in the next section which continues the cycle. Thus on January 1st, at the commencement of the period, we find sub-division 1, of section A, is partially in young plant canes, having been previously prepared with farm-yard manure; at the end of the first year we are referred to sub-division 1, section B, where the same crop is continued; at the end of the second year, to sub-divison 1, section C, where we find that, the ratoons being cut off, the land is manured with pigeon peas; at the end of the third year we are referred to sub-division 2, section A, where we find the young plant canes are stated to be planted after being *manured with pigeon peas;* at the end of fourth year the reference is to sub-division 2, section B; at the end of fifth year to sub-division 2, section C, where we find that, after the ratoons are cut off, the land is planted in Bengal beans; at the end of sixth year we are referred to sub-division 3, section A; at the end of seventh year, to sub-division 3, section B; at the end of eighth year to sub-division 3, section C, where the land after the ratoons are cut off, is manured with farm-yard manure, &c.; and at the end of the ninth year we are referred to sub-division 1, section A, where we find exactly the same state of things as in the first year of the cycle, viz., young plant canes *after yard manure.*

Another mode of working the diagram for large estates may be shewn by calling each field on the estate by the acre-numbers in the sub-divisions, thus—say the acre numbered 1, in sub-division 1, section A, is a field called $A^{1,\text{ 'sub-division No.}}_{1,\text{ acre No.}}$, and that it is required to know what cultivation the said field will be in, on the first week of December in the sixth year of the cycle; we trace it through as in the last example, and find it in Bengal beans just being ploughed in. What will be the cultivation of field B^{2}_{3}, on the second week in August of the fifth year?—tracing as before, we find that it has been cattle-staked, and is being prepared with farm-yard manure and ploughed, ready for planting in young canes.

Other modes of working it will suggest themselves when the plan of the diagram is understood.

TRIBASIC PHOSPHATE OF AMMONIA AS A PURIFYING REAGENT.

For some little time past the tribasic phosphate of ammonia has been a good deal spoken of amongst some of the continental sugar manufacturers as being a powerful purificant of syrups, and in the *Journal des Fabricants de Sucre*, of 20th June, an article, given below, appeared from a Belgian sugar *fabricant*, who had used the new reagent successfully. The article is entitled: *On the action of and the mode of using the pure tribasic phosphate of ammonia for the purification of syrups.*

I.

When the quantity of saline matters, and especially of free alkalies, (potash, soda, &c.) present in syrups, passes a certain proportion, the boiling, particularly into grain, goes on badly; the concentration of the syrup becoming difficult, gives place to what is called heavy boiling, and the *masse* which results is more or less viscous. This consistency of the *masse cuite* is very prejudicial to the yield, inasmuch as it prevents the crystallization of a considerable quantity of sugar. In some cases, either from the bad quality of the beetroots or from defective purification of the juice, the *masse cuite* becomes so viscous that all crystallization of sugar is rendered impossible.

Successive refiltrations through animal charcoal, which will absorb a certain proportion of the saline matters, would appear to be a sufficiently efficacious means of correcting the too saline state of these viscous boilings. But it must be remembered that the purifying action of char is exercised to a much less extent on syrups than on juice. Further, the potash, which accompanies the saline matters, is only feebly absorbed by the char when in a free state, but much more so when saturated by an appropriate acid. Therefore this saturation is sought to be realised by the use of various ingredients, notably of chloride of calcium, hydrofluo-silicic acid, &c., &c.

Of all the substances which have been tried up to the present time, none have been found so efficacious as the pure tribasic phosphate of ammonia. Under the influence of a temperature approaching the boiling point this salt undergoes decomposition. The phosphoric acid unites with the alkalis and by saturating them, forms phosphates on which the absorbing action of the char is very powerful. As to the ammonia which has become free it is disengaged. No other new substance is introduced into the syrups, except the phosphoric acid, which remains completely combined with the alkalies and the lime, which are afterwards easily eliminated by a simple filtration through the char. But to prevent the syrup retaining any *free* phosphoric acid it is necessary previously to determine the quantity of alkali which is contained in the *masse cuite* or the syrup, which it is required to saturate. This problem is solved by the determination of the degree of alkalinity, by means of normal nitric acid.

(It is well known that an acid or an alkali is called normal when a *litre* contains one equivalent of real acid or of pure alkali.)

At the same time it may be remembered that the degree of alkalinity of juice or syrups does not only proceed from the alkalies named, but also from a small quantity of lime, which is purposely left in them to prevent fermentation. The calculation then may be made without serious error as though all the alkalinity proceeded from the lime.

II.—Application.

In order that the mode of proceeding may be the better understood, I give below an example such as occurred in the establishment of a *fabricant* in Belgium, on the 2nd of March last.

A *masse cuite* (2nd boiling) of 18·30 hect. capacity, (about 402 gals.,) had become so viscous that after being many weeks in the crystallizer it was possible to draw out threads of it nearly a yard long, without any appearance of crystallization. To determine the degree of alkalinity, I weighed 30 grammes of this *masse cuite,* which I dissolved in 100 c. c. of distilled water. By slowly dropping normal nitric acid out of one of Mohr's urettes, until the blue litmus paper began to turn of a light red, I found that it was needful to add 2·4 c. c. of the normal acid to effect the saturation. Now, as 1 equivalent of lime = 28 is saturated by 1 equivalent of normal nitric acid, or 1 litre,—1 cubic centr. of normal acid will saturate 0·028 of lime, which multiplied by 2·4 gave 0·0672 as the quantity of lime.

But as I operated on 30 grammes, I obtained the proportion centisimally thus :

$$30 : 0{\cdot}067 :: 100 : x = 0{\cdot}223$$

Therefore, in 100 parts of *masse cuite* there were 0·223 of lime. On the other hand :—the composition of neutral phosphate of ammonia in equivalents is as follows :

2 equivalents, NH_4O = 52
1 ,, HO = 9
1 ,, PO_5 = 71

whence, 1 ,, NH_4O,PO_5 = 132

To determine according to this composition the quantity of this salt which it was necessary to use, in order that the phosphoric acid which it contained might be sufficient completely to saturate the alkalies calculated according to the alkalinity of lime, we had to take.

Eq. Ca. Eq. NH_4O,PO_5 Ca. in 100 of *masse cuite*—
28 : 132 : : 0·223 : x

$$x = 1{\cdot}05$$

Thus, to 100 parts of *masse cuite* it was needful to add 1·05 of phosphate of ammonia.

The dimensions of the crystallizer in which this *masse cuite* was placed, have been given as 18·3 hect. (402 gallons), and 1 hect. weighed 149 kilogrms. (328 lbs.) Therefore

Kilog. Hect. Kilog.
149 × 18·30 = 2726·70 of *masse cuite*, and,
M. cuite. NH_4O,PO_5 Kilog. Kilog.
100 : 1·05 : : 2726 : x = 28·62

After having added to the 2726 kilogrs. of *masse cuite* sufficient water to make it into a syrup, we then added to it the 28·62 kilogrs. of phosphate of ammonia dissolved in water. A dirty red precipitate was formed, and in order to favour this precipitation the whole liquid was carried nearly to the boiling point, by which a disengagement of ammonia was produced. At the end of half an hour the liquid was filtered through ordinary bag filters, and then through animal charcoal. The filtered syrup boiled well, and did not show the least viscosity; and the *masse cuite* put into crystallizers, soon showed an abundant crystallization of good looking sugar.

Thus, then, from this viscous *masse cuite*, from which no particle of sugar could be extracted, and which would certainly have been run into the molasses, there was (by means of the pure tribasic phosphate of ammonia) sugar extracted as in ordinary good boilings.

In the use of phosphate of ammonia, it is no loss to the *fabricant* that this salt has only a purifying action on the syrup, and none on the juice; as it is the contrary with the carbonatation and the char, of which the purifying action is exercised more strongly on the juice than on the syrups. It will be seen from this, that the pure tribasic phosphate of ammonia may form in certain cases, a very useful supplementary eliminating agent.

CENTRIFUGALED CONCRETE.

We have received from one of the Montserrat estates of Messrs. Sturge a sample of Fryer's concrete centrifugaled. The grain of this sugar is small, and the colour most excellent, in fact, fully equal to 14½ Dutch standard, and closely resembles fine vacuum pan clayed Havana or Java, from which in fact it would be undistinguishable, if the sugar had been sun-dried. We are informed that "the concrete was not specially prepared, but was concreted in the usual way, then broken up and put in the centrifugal."

The analysis of this sugar is as follows:—

Cane sugar	98·0
Inverted sugar	0·13
Ash	0·4
Moisture	0·7
Other substances, by difference	0·77
	100·00
Colour Dutch standard	14½
Colour of solution	12

We have compared this with another sample of concrete treated in a somewhat similar manner, from a neighbouring colony. There was however this difference in the mode of preparation. The syrup in the latter case had been removed from the trays after traversing about half their course, and when the density had been increased to 24° B. It had been passed through bag-filters of the ordinary construction and allowed to complete its course in the usual manner. The concrete removed from the cylinder at a somewhat less density than usual, stood for several days before it was dried in the centrifugal machine. By this mode of treatment all slight feculencies were removed and the sugar assumed a more brilliant or bloomy hue.

The analysis of this concrete, the syrup composing which, has passed through bag-filters, was as under :—

Cane sugar	92·5	per cent.
Inverted sugar	2·3	
Ash	1·0	
Moisture	2·6	
Other substances, by difference.	1·6	
	100·0	

*Colour Dutch standard	14½.
Colour of solution	10

The latter sugar possesses a bolder grain than the former. It would appear that if the conditions were equal, the simpler mode of treatment adopted on Messrs. Sturge's estates was the better one for the production of raw sugar, for the use of the maker of loaf, or the finest crystals, as their sample leaves nothing to be desired either in purity, or absence of glucose.

For purposes of comparison, the analysis of a fair sample of Montserrat muscovado sugar may be given :—

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* The Dutch standards range from No. 6, a very dark brown sugar, to No. 20, which is white. The colours of solution range from 0, which is colourless, to 1000, which resembles new port wine.

Cane sugar	85·6
Inverted sugar	4·4
Ash	·8
Moisture	5·7
Other substances, by difference.	3·5
	100·0
Colour Dutch standard	9
Colour of solution	60

We have not been informed of the percentage of sugar produced from the concrete by the centifugal, and without this information it is impossible to judge whether the manufacture of the whole of the juice into finest raw and molasses is more or less profitable than the conversion of the same into concrete.

We have heard of several instances in which the molasses draining from the centrifugaled concrete has been mingled with the syrup in the Concretor tank. By this means the amount of molasses eventually produced was insignificant, but whether or not it would have been better to discard the centrifugal altogether, it would be interesting to ascertain.

SEAWEED AND LIME AS CANE MANURE.

Enquiries have been lately made by an esteemed correspondent as to the value of a mixture of seaweed and lime and of salt and lime as manures for the sugar cane. In reply, we are able to state on good authority that the mixture of seaweed and lime will answer well—provided the lime is used in proper proportion. One part of lime to three parts of seaweed (by weight) would form a valuable manure, used about three cwts. to the acre.

As to the lime and salt mixture it could do no harm, and would probably benefit most soils, used about 1½ to 2 cwts. to the acre, and, if possible, just before the setting in of the rainy season.

On the subject of the fertilizing properties of seaweed, an article recently appeared in the *American Chemist*, by Professor S. W.

Johnson. Though chiefly relating to those species of seaweed thrown upon the shores of the United States; it will no doubt interest many of the readers of *The Sugar Cane,* we therefore transfer it in full to our pages.

SEA WEED AS A FERTILIZER.

The sea-weeds that are thrown up on the shores of salt water have long been prized in this country, as in Europe, for their fertilizing action when applied to the soil. The annals of Scotch and Irish husbandry contain ample testimony to their value; and it has been asserted that the recent great advance in the cost of iodine largely depends upon the fact that much of the sea-weed which was formerly burned for the iodine makers, is now employed for agricultural purposes.

Analyses of various marine plants of Europe have been made especially by Forchammer in Denmark, and by Anderson in Scotland, but I am not aware that chemical examinations of any sea-weed from American waters have been published hitherto.

In 1860, Wm. H. Bergen, Esq., of New York City, then studying chemistry in the Yale Analytical Laboratory, made an ash analysis of so-called 'eel-grass' gathered on the shore of New Haven harbour. This material was not identified with certainty, but, probably, consisted, for the most part, of *Fucus sessates.* It was not altogether botanically homogeneous, and was, furthermore, analysed as it came from the water, with various mollusks, and other small marine animals, adhering—the object being simply to ascertain its fertilizing value.

This 'eel-grass,' so called, was examined in the air-dry state, and contained:

Moisture	17·75
Organic matters (by difference)	64·64
Sand	2·94
Silica	2·78
Sulphuric acid (SO_3)	0·54
Phosphoric acid (P_2O_5)	1·01
Oxide of iron (Fe_2O_3)	0·72
Oxide of manganese (Mn_3O_4)	0·26

Lime	2·73
Magnesia	1·82
Potash	0·94
Soda	1·14
Chloride of sodium (and iodide of sodium)	2·73
	100·00

The crude ash=19·34 per cent.

Nitrogen was not estimated.

In 1862, Dr. Samuel Myers, of New Haven, put in my hand, for analysis, a sample of the dry forms of a sea-weed from the shores of Maine. This material was identified by Prof. D. C. Eaton as the *Laminana Saccharina*, or Kelp-weed, and the analysis made by myself gave the following result:—

Moisture	9·81
Organic matters (by difference)	71·41
Sand and silica	0·13
Sulphuric acid (SO_3)..	6·19
Phosphoric acid (P_2O_5)	0·57
Oxide of iron (Fe_2O_3)	0·26
Lime	1·40
Magnesia	0·20
Potash	2·46
Soda	1·64
Chloride (and iodide) of sodium	5·93
	100·00

The crude ash=20·5 per cent.

Nitrogen=1·77, equivalent to ammonia 2·15 per cent.

Finally, I have recently examined a sample of a commercial article brought into the trade by the Quinnipiac Fertilizer Company of New Haven, under the name of "Kelp Fertilizer." This is simply sea-weed, dried and reduced to such pulverization, that it readily passes a sieve with ¼-inch meshes. Prof. D. C. Eaton pronounce the samples I analysed to be chiefly *Fucus nodusus*, or rock-weed.

Its composition, as taken from a bag of 100 lbs. weight, was:

Moisture	11·01
Organic matters (by difference)	69·10
Sand	1·59
Sulphuric acid (SO_3)	6·82
Phosphoric acid (P_2O_5)	0·28
Lime	1·10
Magnesia	1·19
Oxide of iron (Fe_2O_3)	0·37
Potash	2·18
Soda	2·22
Chloride (and iodide) of sodium	4·14
	100·000

The crude ash=21·13 per cent.

Nitrogen=1·20 equivalent to ammonia 1·46 per cent.

In this analysis, the dried substance was carbonized at a low heat, and extracted with water, before incinerating.

Mr. Bergen, if I rightly remember, incinerated directly, and, in all probability, thereby occasioned severe loss of sulphuric acid, and, perhaps of chlorine. The last two analyses agree together quite closely, and they all explain the high fertilizing effect of sea-weed. On comparison with stable manure of good quality—using the average of a number of analyses of the latter,—it appears that the relative quantities of the active ingredients are expressed by the following figures:—

	Stable Manure.	Kelp Fertiliser.
Organic matter	1	5 to 6½
Nitrogen	1	2—3
Phosphoric acid	1	1—2½
Sulphuric acid	1	23—25
Common salt	1	37—54
Soda	1	23—32
Potash	1	3—4
Lime	1	2—2½
Magnesia	1	1—6

It thus appears that by the addition of 30 lbs. of fish guano (containing 2 lbs. each of nitrogen, phosphoric acid, and lime) to

1,970 lbs. of the dry kelp, the ton of mixture would be worth, as far as can be judged from the quantity of the several solid ingredients, five times as much as the best stable manure. This consideration is one of high importance where, as in the Connecticut valley, stable manure sells for 10 dols. to 15 dols. per cord, and often cannot be got at any price. The mixture named makes a pretty close imitation of stable manure in a dry, and, therefore, concentrated form.

When used fresh from the sea-shore as thrown up by the tide, sea-weed speedily suffers decomposition, and disappears in a short time; its saline ingredients become a part of the soil, but its organic matter would seem to be of little permanence.

Once dried, however, it becomes a rather slow-acting fertilizer; and in various instances where it was used in field trials last year, it gave the best results when applied very early, so as to become fully swollen with the spring rains. It is deemed advisable to use with it a small quantity of some active nitrogenous manure.

Sheffield Scientific School,
New Haven, Jan. 13, 1872.

ON THE INFLUENCE OF FORESTS ON RAINFALL.

By Alfred Fryer.

(Continued from page 375.)

"*Mr. Marsh*, who is well acquainted with North America from long residence in it, and has deeply studied the influence of forests on climate, observes that the—

"'Uplands in the Atlantic states formerly abounded in sources and rills, but in many parts of these states, which have been cleared for a generation or two, the hill pastures now suffer severely from drought, and in dry seasons no longer afford either water or herbage for cattle.'

"'This fact is so familiar throughout the American states and the British provinces, that there are few old residents of the interior who are not able to testify to its truth as a matter of personal observation. My own recollection suggests to me many instances of this sort. I remember one case in particular, where a small mountain spring, which disappeared soon after the clearing of the ground where it rose, was recovered ten or twelve years ago, by simply allowing the bushes and young trees to grow up on a rocky knoll, not more than half an acre in extent, immediately above it, and it has since continued to flow uninterruptedly.'

" *Blanqui*, in his travels in Bulgaria, says:

" 'The terrible droughts which desolate the Cape Verd islands must be attributed to the destruction of the forests. In the island of St. Helena, where the wooded surface has considerably extended within a few years, it has been observed that the rain has increased in the same proportion. It is now in quantity double what it was during the residence of Napoleon. In Egypt recent plantations have caused rains, which hitherto were almost unknown.'

" The following cases mentioned by *Boussingault* deserve special mention:

" 'In the island of Ascension there was an excellent spring, situated at the foot of a mountain originally covered with wood. This spring became scanty, and at last dried up, after the trees which covered the mountain had been felled. The loss of the spring was ascribed, and rightly so, to the cutting down of the timber. The mountain was therefore planted anew, and a few years afterwards the spring reappeared by degrees, and by and by flowed with its former abundance.

" 'The metalliferous mountain of Marmato is situated in the province of Popayan, in the midst of immense forests. The stream along which the mining works are established is formed by the junction of several small rivulets, which take their rise in a country thickly wooded.

" 'In 1826, when I visited the mines for the first time, Marmato consisted of a few miserable cabins, inhabited by negro slaves. In 1830, when I quitted the country, Marmato was covered with workshops, had a foundry of gold, machinery for grinding and amalgamating the ores, and a free population of nearly 3000 inhabitants. In the course of these four years an immense quantity of timber had been cut down, for the construction of machinery and of houses, as well as for fuel and the manufacture of charcoal. But the clearing had scarcely been two years effected, before it was perceived that the quantity of water for the working of the machinery had notably diminished. The volume of water was measured by the work done by the machinery; and actual gauging at different times showed the progressive diminution of the water. Now, in the island of Ascension, and at Marmato, it is improbable that any merely local and limited clearing away of the forest should have had such an influence on the constitution of the atmosphere as to cause a variation in the mean annual quantity of rain. Besides, as soon as the diminution of the stream at Marmato was ascertained, a rain-gauge was set up; and in the second year of observation showed a larger quantity than in the first year, though the clearing had been continued, and though there was no appreciable increase in the size of the running stream.

" 'Two years' observations are insufficient to show any definitive variation in the annual average quantity of rain. But, so far as they go, they show that at Marmato the mass of running water had diminished, in spite of the larger quantity of rain which fell. It is therefore probable that local clearings of forest lands, even of very moderate extent, cause springs and rivulets to shrink, and even to disappear, without the effect being ascribable to any diminution in the amount of rain that falls.'

"*Marschaud*, a German philosopher, supplies the following remarkable cases:

" 'Before the felling of the woods, within the last few years, in the valley of the Soulce, the river Sorne furnished a regular and sufficient supply for the ironworks of Unterwyl; and it was almost unaffected either by drought or by heavy rains. The Sorne has now become a torrent, every shower occasioning a flood; and then, after a few days' fine weather, the stream falls so low, that it has been necessary to change the water-wheels, and at last to introduce a steam-engine, to prevent the stoppage of the works for want of water.

" 'The spring of Varieux, which formerly supplied the Castle of Pruntrut, lost more than half its water after the clearing of the woods. These woods have since been replanted; and, with the woods, the waters of the spring are increasing.

" 'The *Wolf-Spring*, in the commune of Soubey, was much prized by the inhabitants. They remembered when it had not existed; only a small thread of water occasionally appeared after long rains; but after the rain stopped, the rill disappeared. The spot is in the middle of a steep pasture, inclining to the south. Eighty years before, the owner of the land, perceiving that young firs were shooting up, determined to let them grow; and they soon formed a flourishing grove. As soon as they were well grown, a fine spring appeared in place of the occasional rill, and furnished abundant water in the longest droughts. For fifty or sixty years the spring was considered the best in the Clos du Doube. A few years since, the grove was felled, and the ground turned again to pasture. The spring disappeared with the wood, and is now as dry as it was seventy years ago.'

"*Strzelecki*, in his account of the climate of Van Diemen's Land, gives the following facts:

" 'The influence of winds, great as it may be, is not the only one which increases or diminishes the fall of rain. That of vegetation is nearly equal to it. The refrigerating powers of plants, acquired through the nocturnal radiation of heat, and their feeble absorption of heat during the day, is exemplified in a striking manner by a comparison of the quantities of rain condensed by two mountainous districts—the one richly wooded, the other but scantily clothed with vegetation. On Middlesex plains, a dependency of the Circular Head Company, 2700 feet above the sea, the fall of rain is less than on the Hampshire hills, which average 1800 feet above the sea. The rich arborescent vegetation found on the latter, and the partial barrenness of the former, thus differently influence the condensation of the floating vapours.

" 'The influence of vegetation on the amount of rain is still better exemplified by a comparison of the registers of the two stations of the Van Diemen's Land Company. At Circular Head, a neck of land which projects into the sea, clear of timber and under cultivation, it rains less than at Woolnorth, also on the sea coast, and equally exposed to the north, but surrounded by a thick forest of luxurious growth.

" 'The climate of New South Wales and Van Diemen's Land is very different from what it was before these colonies were brought within the pale of civilisation. The destruction of thick herbaceous underwood *scrubbs*, and thick interwoven *forests*, must have necessarily rendered the climate drier. The 250,000 acres of cultivated land, freed from the bad conductors of heat which covered them, have contributed towards the increase of the mean annual temperature. The climate, though thus drier and hotter, is far from being improved. A still further development of the science of civilisation is wanted to check the evils, with which the lack of moisture and the presence of parching heat threaten the interests of agriculture.'

"*Mr. Meldrum*, the Director of the Mauritius Observatory, a Government institution, supplies some interesting facts. He says:

" 'That the rainfall in that island during the five years 1862-66 was considerably less than during any previous five years of the whole period since 1853;'—'that during the first five years, from 1853-57, the relative humidity of the air was 72·1, whilst during the last five years, 1862-66, it was only 68·2;'—'that the vapour pressure, which in the earlier of these quinquennials was 6·57, had fallen during the latter given quinquennial to ·638.'

"Notwithstanding these facts, *Mr. Meldrum* says:

" 'In no former year of the period of fourteen years did such floods occur as in 1861 and 1866, or such severe droughts as in 1865 and 1866.'

"How does *Mr. Meldrum* account for these facts? He says:

" 'That the decrease of rainfall, humidity, and vapour pressure, and the occurrence of floods and droughts, may in some measure be due to the cutting down of the forests, which commenced on an extensive scale about 1852, was vigorously carried on till 1862, and is being still prosecuted, though to a smaller extent.'

"One chief cause of the cutting down of the forests in the Mauritius, *Mr. Meldrum* states thus:

" 'Proprietors of forests in high and remote parts of the island, where the climate was as yet too damp and rainy for the sugar-cane, engaged in the work because they believed that their land would thereby become more fit for such crops; for it was very well known that the climate became drier in proportion as the forests were cut down. Upon the whole, I think, at least 70,000 acres, or about one-sixth of the entire area of the island, have been denuded of forests since 1852, and that, too, on the central and elevated parts of the island, at or near the sources of the rivers.'

"*Mr. Meldrum* next points out how, by the lowering of lakes, and the complete desiccation of others, malaria resulted, and a deadly epidemic. The remedy which he suggests is, 'to restore, as far as practicable, certain portions of the forests of which this once salubrious and beautiful island has been deprived.'

"Some valuable facts are supplied from the island of Madeira. It has been shown that the annual fall of rain there is, on an average, thirty or thirty-two inches, being about thirteen inches more than at Malta. Can one reason be, that whilst Malta is treeless, Madeira is still partially wooded? *Dr. Graham* says:

"'The north side of Madeira is still well clothed; and although there are perhaps few trees which can aspire to the dimensions handed down to us in the relics of former days, the dark and ancient foliage still covers both hill and valley.'

"*Dr. Graham* refers to the dimensions of the trees of a bygone age at Madeira. There can be no doubt that, when first colonized, the island had been completely covered with wood. Its name, as given by the Portuguese, was originally *Materia*, in allusion to the inexhaustible materials it supplied for shipbuilding and the construction of houses. *Dr. Graham* quotes, from an unpublished ancient manuscript, the following glowing description of its woods and waters:

"'The island of Madeira at the period of its discovery presented a most lovely picture of nature: a vegetation truly astonishing covered it with trees, reaching to a prodigious height,—the majestic cedar, laurel, til, besides others, forming one continuous and impenetrable forest. Evergreens and creeping plants wove their festoons from branch to branch, giving new shade to a land all clothed with vegetation, and new force to *innumerable springs of pure and salubrious water.*'

"In the life of Columbus, by Washington Irving, a still more ancient document is referred to, which is believed to have been drawn out by one of the first discoverers of Madeira, about the year 1378. The following are extracts:

"'The country was delightful. The forests were stately and magnificent. There were trees laden with excellent fruit. The *waters were cool and limpid.* On penetrating a little distance they found a beautiful sheltered meadow, the green bosom of which was bordered by laurels, and refreshed by a *mountain stream which ran sparkling over pebbles.*'

"It seems very evident from these descriptions, that Madeira, when first colonized, was much better supplied with both wood and water than at present; and the conclusion seems not unreasonable, that the better supply of water was in consequence of the larger extent of wood.

"*Dr. Graham* expresses a decided opinion to that effect. He condemns unsparingly the selfishness and folly of the first colonizers, who, in order to get land for the culture of the sugar-cane and vine, set fire to the woods and produced a conflagration which is said to have lasted seven days. He says that:

"'When the hills were completely wooded, at the time of the colonization, it is quite probable that the humid mists, continually passing over the mountains, were intercepted, and that the rivers, which now, soon after rain, dwindle down to tiny streams, were then more constantly full.'

"Elsewhere he says:

"'The power of trees upon mist is very great. Where there are no trees, the cloud drives along, depositing little or no moisture. But trees largely intercept mist; and the small component vesicles of water coalesce upon the leaves and branches, and fall in drops of water upon the earth. The mists form, whether there be trees or not; but the water is strained out and saved by the forests foliage.'

"'In one of the Canary Islands the people show the place where, at the head of a deep valley, stood a fine solitary til tree, which daily used to strain a large quantity of water from the humid mist, conveyed inland by the sea breeze. The tree is mentioned by Cordeyro and subsequent writers. But both the spring of water and the tree are now gone; and the mists, though they still remain, pass over, unstrained of their moisture.'

"*Dr. Graham* has prosecuted his inquiries, so far, as to note the trees whose foliage strains out most water from the passing mists. He says:

"'I have watched with much interest for the commencement of dripping, in reference to the pre-eminence of certain kinds of foliage in power of condensation. The *pine* trees invariably begin first, their rough brush-like clusters of leaves being well adapted to intercept the smallest particles of moisture. The yield of water from this source is very great. The *laurels* extract water plentifully from mists which are more sensibly damp.'

"*Dr. Graham* alludes to another advantage which would result were Madeira better covered with woods,—viz., the avoidance of injurious floods, and a more steady supply of water in the streams. He says:

"'On the eastern side of the basin of Funchal the upper lands have been almost entirely cleared of trees. The rain water descends impetuously in a torrent, leaving a tiny stream, which flows steadily so long as the sky is overcast, but ceases altogether after one day of sunshine. I do not think the rains are now heavier or more fitful than in former times; but there are now no woods on the south side to restrain the drops which unite to denude the rocks of their soil, and to form the mighty torrents witnessed every winter. I do not doubt that the planting of trees in the valleys at the head of the main ravine would lead rapidly to a nearly constant supply of water in a region where it would be useful.'

"That this seems also to be the opinion of the local Government of Madeira, appears from several incidental notices in *Dr. Graham's* book. Thus he says:

"'The recession of native woods has been *in late years compensated* by the advance of introduced species.'

"To none of the species introduced does *Dr. Graham* attach so much importance as the *Pine:*

"'The forests of Madeira have been continually receding with the increase of fuel requirements, and the replanting of the lands thus laid waste has been long and culpably neglected. *Recently, however,* the *introduction of the pine tree* has to a very great extent stemmed the progress of reckless destruction. The pine grows easily and rapidly, occupying land ill suited to other kinds of cultivation.'

"Under the foregoing head it has been sought chiefly to refer to facts, showing how closely connected is the supply of wood and water in a country; that, when forests have been destroyed, a steady supply of water ceases; and that, when a country has been replanted, the water returns. What is the explanation of these facts? Are they due to any local peculiarities of the countries where they occurred, or are they due to general principles applicable to all countries?

"In some of the cases it is mentioned that, after the woods had been cut down, less rain fell than before. We know that rain falls everywhere, more on the mountain than on the plains. Why? Because the vapour, when forced into a higher region of the atmosphere, is more apt to be condensed. The rarer and cooler the atmosphere, the less vapour will it hold: a portion is condensed into fog or mist, and ultimately into rain. In like manner, a belt of wood, obstructing a current of air loaded with vapour, especially if the trees are of considerable height, causes the vapour to rise to a higher level, and exposes it to the probability of condensation.

"It must also be kept in view, that these atmospheric vapours are the more likely to be condensed, by coming in contact with the foliage of trees, which, as has been shown, are in summer weather always colder than the ambient air. Therefore there need be no difficulty in understanding why the quantity of rain should increase as woods increase, and why there should be less rain as woods are cut down.

(To be continued.)

METEOROLOGICAL OBSERVATORY IN BARBADOS.

The following letter—extracted from the *Barbados Globe*—addressed to Governor Rawson from the "office of the Chief-signal Officer, Washington," will show with what approval the establishment of an Observatory in Barbados, is regarded in quarters where opinion on the subject is valuable.

The letter is dated 13th April, 1872 :

"Sir,—Although a stranger, I beg you will excuse the liberty I take in addressing you upon a subject in which, in common with the whole scientific and commercial world, I feel a very deep interest. Through the kindness of a friend in New York, I have seen your meteorological labours in the Rainfall Returns for 1871, which I doubt not, will in time become of great value to the West Indian agriculturists. My object in now writing, however, is to ask you co-operation in the extension of your present scientific labours to the work of the weather telegraphy in your Island. My labour as meteorologist in this office, charged with the duty of making daily weather forecasts and Storm warnings, convinces me that in the great trade-wind belt alone, can we ever expect to gain early information of the devastating Storms and Cyclones which emerge from the Tropics, sweep over the United States, and subsequently, move in the belt of the passage winds, (the S.W. Antitrades of the North Atlantic) and break upon the British Islands. The Azores have been urgently recommend by many European meteorologists as most important stations for their sciences, but in my opinion, the gales which sweep over the Azores come around them towards the S. E. and do not reach England ; in this opinion too I am sustained by the inquiries of Captain Henry Toynbee, the able Marine Superintendent of the London Meteorological Department of the Board of Trade. The island of Barbados, however, is so happily placed in the midst of the Tropical Atlantic, that she may keep perpetual vigil over the fiery meteory, which is generated just east of her. The great problem of Storm science now is the origin of Cyclones. My own views have been formed on this subject after considerable study and reflection, and I am satisfied that they are correct in fixing the birth of the hurricane in the belt of interference of the N.E. and S.E. trade winds.

The settlement of this question cannot be looked for, however, until we have meteorologic observations in the Atlantic between the parallels of 10° and 15° N. latitude, where this belt of conflict between the Trades is to be found during the hurricane season. I hear casually of the probability of the authorities of Barbados establishing a system of meteorologic reports. Were this undertaken, even on a small scale, it would be of incalculable service to the shipping of the whole world, and would, no doubt, speedily lead to many brilliant meteorologic discoveries in the West Indies—the great laboratory of the atmospheric ocean.

In the United States this weather system has become, in an incredibly short time, the most popular branch of the Government, and it has already been the means of saving hundreds of lives and millions of dollars'-worth of property. Your natural advantages and facilities for such success are unequalled; and if you should embark in this work, you would lay the cause of science, the commerce of the world, under the greatest obligation, and make your island a centre of new interest and importance among all civilised nations. Should your Government enter upon the work, you will soon be *en rapport* with the general and world-wide system of research first proposed at the Brussels Conference in 1854, now soon to be spread as an immense and beneficent net-work all over Europe, the East Indies and America.

I sincerely trust and believe you will take this matter much to heart, and I am sure the people of Barbados, without delay, will enter into it with spirit and enthusiasm. Please excuse the liberty I have taken, and believe me,

Your obedient servant,

THOMPSON B. MAURY.

Governor Rawson, C.B."

THE ROBERT CENTRAL FACTORY COMPANY, MARTINIQUE. CAPITAL, £56,000.

[*From the Report of the Committee.*]

The profits of manufacture realized in the season of 1871 have reached £8,493.

This is shown as follows:—

The factory has crushed 22,924 tons of canes which have produced 1,385 tons of sugar of all crystallizations (1,000 kilos to one ton.)

These sugars, sold or valued at market price, produced the sum of		£38,977
Rum		5,035
Syrup		1,016
Total		£45,028
From this deduct purchase of canes	£25,728	
Expenses of manufacture, repairs, stores consumed, &c.	10,807	36,535
Profit of Manufacture..		£8,493
From this sum must be deducted for loss on freight, for interest, &c.		516

The nett profit of the season is then conformably to the balance sheet of 31st Oct. last, found to be reduced to £7,978

From these figures we draw the following conclusions :—

1st. That the 22,294 tons of canes having only produced 1,385 tons of *usine* sugar, the return has been 6·21 per cent.

2nd. That the sale of 1,385 tons of *usine* sugar having only produced £38,977 ; the average price is about 27/- per cwt., which shows a difference of 5/10 compared with the average price of 21/2 per cwt. paid to the sellers of canes.

3rd. That the profits of manufacture being £8,493 and the number of tierces made 2,769, the profit is about £3 per tierce.

4th. Lastly, as the expenses of manufacture, of repairs, and of other things being provisionally £10,807 (270·177), the expenses per tierce are (97·57) £3 18s. We say provisionally because there are some expenses of repairs of the barges which have not figured in the balance sheet struck on the 1st October, although belonging to the season of 1871.

It now only remains that we should inform you of the dividend which may be distributed.

The total profit realized is		£7,978
From this must be deducted—		
1.—Interest on capital, paid on the 1st of June, 7 per cent	£3,920	
2.—Expenses this year on the establishment of the factory	1,221	
Reserve Fund	2,800	7,941
		£37

Which will yield about 6d. per cent. and there will remain about 7/6 to the credit of profit and loss account.

The result of this second season, is, as you see, gentlemen, very nearly the same as that of the season, 1870. We hope, however, that under the able direction of M. Bougenot we shall see realized all the hopes which we have conceived of the Factory *du Robert*.

DU SIMON CENTRAL FACTORY COMPANY, (MARTINIQUE).

Capital, £30,000; in 1,500 Shares of £20 Each.

Report of the Committee of the Central Factory du Simon, presented to a General Meeting of the Shareholders, 27th December, 1871.

Gentlemen,

On behalf of the Committee of Inspection and in performance of the 41st Article of the statute, we render you an account of the examination which we have made of the books of the company.

Our company formed the 24th of June, 1869, commenced its first season in 1871, in accordance with the terms of the statute of contracts entered into with the suppliers of canes.

According to Article 31 of this statute and the law of public companies a General Meeting of the Shareholders must be called every year at the expiration of the company's financial year, to hear the report of the Committee of Inspection on the state of the Company, and to approve, if it sees fit, the accounts of the Director.

This obligatory meeting of shareholders would have been held at the beginning of January last, but the manager not having then received, because of the siege of Paris, the *materiel* of the factory supplied by Messrs. Cail & Co., and thus finding himself unable to make out a proper balance sheet, the Committee of Inspection was unable on its part to present to you as in duty bound, a report of the situation of the Company, such as would have enabled you to pass the accounts of the Director.

The Report which the Committee has the honour to present to you this year comprises, thus, necessarily two distinct parts. The first will inform you in detail of the use to which the capital of the company has been put and what the establishment of the factory has cost.

Our Company was formed with a capital of £30,000, which remained entire in the hands of the Director, and had not to submit to a half-yearly payment to the shareholders of the Company as interest on the sums invested by them, reckoned from the day of investment interest which taken from the capital to the diminishing of its amount.

PURCHASE OF THE MATERIEL OF THE FACTORY AND THE RAILWAYS.

Materiel of the Factory, comprising the principal building, and an accessory building serving for warehouse and forge		£15,032
Expenses of packing		399
Carriage from Paris to Havre	£431	
Interest on this *Materiel*	75	
Materiel bought in the Colony	680	
		1,186
		16,617

MATERIEL FOR RAILWAYS.

Rails, cramps, and bolts	1,412	
Wheels and axles of Waggons	260	
Pedestals	14	
Carriage from Paris to Havre	152	
		1,838

MATERIEL FOR RAILWAYS BOUGHT IN THE COLONIES.

Thirty Waggons, materials and making	240	
Fourteen Mules	532	
		772

ERECTION OF THE FACTORY.

Freight of *Materiel*	506	
Customs duties	302	
Expenses of Erection	8,680	
		9,488

CONSTRUCTION OF THE RAILWAY.

Nearly 3¼ Miles.

Payment to Contractor, including sleepers	1,916	
Material for Stone work	131	
		2,047
Utensils		14
General Total		£30,737

The expenses of the erection of the factory notwithstanding all possible economy, thus amounted to £30,737, and the capital subscribed and paid up only amounted to £30,000, the result of which is that the Company began its first season with a debt of £737, a debt which was to be deducted from the average profits realized during the season, which was only partially possible as you will see further on in the distribution of the profits.

II.—Season of 1871.

The profits of the season of 1871 amounted to £5920, and were realised thus—

Sugars of all crystallizations	£21,319	
Rum	2,975	
Syrup	400	
		£24,685
From which must be deducted—		
1st. Purchase of Canes, 13,294 tons.. ..	15,321	
2nd. Expenses of Manufacture, supplies and stores	3,443	
3rd. General Expenses	728	
4th. Repairs	373	
5th. Loss of one Mule	38	
		19,905
Excess of returns over expenses		£4,780

Such is the profit resulting from sugar and rum realized, or shipped, and from those in the warehouse of the Company on the 31st October not sold, but of which the value is carried to account of manufacture at the market price of the time on the spot.

This profit of £4,780, which is 15·93 per cent. on your capital of £30,000 is not, however, the whole of what is realized by the Company and which may be divided as profits at the end of the Company's financial year.

To this figure	£4780
The balance of the interest account has been added, which leaves to the Company a profit of	60
	£4,840

Such had been the actual profits of the Company's first season if all the sugar and rum had been sold on the spot. Unfortunately such was not the case. The greater part of those sugars were shipped, and the greater part of these already sold has entailed a loss of £643, which deducted from £4840, leaves a balance of £4,197, say 13·99 per cent., which has been thus distributed on a sum of £4,197

Paid to the shareholders in accordance with Article 46, 1, 2 & 3 of the statute, interest at 11 per cent. on their capital from the day when paid up	3,937
Remaining	£260

After payment of interest to the shareholders by the terms of Article 46,—3 per cent. should be deducted to form a sinking fund, and the surplus of the profits should be devoted to the formation of a reserve fund, until this fund reaches one quarter of the whole capital of the Company. But the Company having gone beyond its capital in the purchase and setting up of a factory by a sum of £736 the £260 should be devoted before all things to the payment of a part of this debt, with which as has been said the Company commenced its first season, because it is the rule with public companies that distributable profits shall only be the excess of realizable assets over present liabilities.

From the figures which we have placed before you the following conclusions may be drawn.

1st. That 13,294 tons of cane have only yielded (of sugar of all crystallizations) 775 tons of sugar and 74,800 gallons of syrup, of which 63,800 gallons were converted into rum, and 11,000 gallons remaining in the cisterns to commence the distillation at the beginning of the season of 1872.

The return of sugar was ..	5·83	per cent. of the cane.
That of syrup	2·55	,, ,,

2nd. That the sugars, syrup and rum having yielded a profit of £4,780 for those sold, or at the same valuation for those shipped, and for those in warehouse here on the 31st October,—the profit per hhd. of sugar is £3 2s.

3rd. That the expenses of all kinds for the season being £4,482, and the number of hhds. being 1,550, the expenses have reached £2 19s. per hhd.

This result which is far from responding to the hopes which the founders and the shareholders of the Company had conceived, is owing to the bad return of 5·83, per cent. on the weight of cane, which is inferior probably to those obtained by the other factories of the island. [The Report proceeds with an examination of the various reasons that might be adduced to account for the small yield of sugar, among others the peculiarity of the season, possibility of defect in the weighing machines and of want of "loyalty" on the part of the agriculturists, and then compares the present condition of the company with what might have been expected if the results had equalled those of the Factory *du Francois* for example, which realises an average return of 7·50.]

The factory has crushed 13,294 tons of canes, which would have given with a return of 7·50—997 tons of sugar.

These Sugars at the average price at which those of this season have been sold would have produced		£26,603
Plus the product of the distillery		1,234
„ „ Syrup		400
Total		£28,237
From which deduct—		
1st. Price of Canes	£15,322	
2nd. Cost of manufacture, &c.	4,582	
3rd. Purchase of 444 hhds.	213	
		20,117
Net Profit		£8120

Say 27 per cent. on a Capital of £30,000, and nearly 16 per cent. on a Capital of £48,000.

Deduct from these profits—

The Interest paid to Shareholders	£3,937	
Sinking Fund	900	
		4,837
		3,283
From which deduct 10 per cent. for the Director		328
		£2,955

Such, gentlemen, are the results which would have been obtained by our Company on its first season with a return of 7·5 [of sugar on the cane].

This result will show in the most evident manner that the profits of a factory depend principally on a good return.

PROFIT AND LOSS ACCOUNT.

	£	£		£
General Expenses	728		Balance of Sugar account	4,685
Renewals and repairs	373			
		1,101	„ of Distillery „	1,234
Loss on Sugar shipped		643	Interest	60
„ „ One Mule		38		
Interest to 30th June		3,937		
Balance		260		
		£5,979		£5,979

LA DILLON CENTRAL FACTORY COMPANY.

The following are the results of the manufacturing season of the year, 1871; from the Committee's report.

Crop of 1871.

The Factory has crushed 11,350 tons of canes, which paid for at 6 per cent. cost		£14,097
Expenses of Manufacture	£3,316	
Supplies, stores, &c.	3,722	
General Expenses	1,203	
Repairs of Railway and of putting the *Materiel* of the factory in order	652	
Divers expenses for bounties, agreements and indemnities to Engineers	185	
Freight of Sugar from *Port de France* to *Saint Pierre*; duties on various shipments, and loss on the shipment of 28 hhds per "Décide"	263	
		9,341
		£23,438
Sugars of all crystallizations, amounting to 842½ tons representing 1615 tierces, which sold on the spot, or shipped, produced	23,196	
Sold .. 24,560 gallons of syrup.		
Distilled 23,364 " "		
Total .. 47,924 gallons producing	1,136	
Remaining in cisterns 19,800 gallons, valued at	506	
		24,838
Profit on Sugar and Syrups		£1,400

Distillery.

The Distillery consumed 23,364 gallons of syrup	584	
Cost of Distilling	166	
	754	
Produce 16,850 gallons of rum, valued at	1,009	
Profits of Distillery		259
Total profits of the season (sugars, syrups, and rum)		£1.659

The 11,350 tons of cane bought having produced 842½ tons of sugar and 47,924 gallons of syrup, the return has been 7·42 per cent. in sugar, and 2·74 per cent. in syrup.

The expenses of manufacture of sugar, of rum, &c., having reached to £9,506, the manufacture of each tierce of half-a-ton, cost the enormous sum of £5 12s., which fact dispenses with all comments on the very small profit of 19/8 per tierce, which gives the return of 7·42 per cent. as above, or 2·76 on the capital of £60,000.

You have, gentlemen, as complete an idea as possible of the result of the season of 1871. We are now about to place before you the net cost of the *materiel* and erection of the factory.

In the report of the 5th June, 1871, you saw that up to the date of the 30th of April last, the general expenses of the erection of the factory had reached £67,736

Add payment of interest to Shareholders			3,137
Together..			70,873
To which must be added on account of advances to April 30			123
			£70,996
Since that date there has been expended *materiel* for the factory, (old account)		1,968	
” ” ” new account		292	
		2,260	
Implements	12		
Interest paid to various shareholders	40		
Materiel—Rolling stock for Railways (old and new accounts)	1,624		
Tramway from factory to wharf	174		
” ” *Point de Negres*..	258		
Advances to Contractors for parts of line from *Point de Negres*, &c., &c.	1,151		
Contractors for various works, repairs, &c., shipping materials, &c.	1,264	4,123*	6,383
Showing the expenses up to 31st October, when balance sheet was made out			£77,379

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* There is an error in one or other of the items comprising this sum of 10,000 francs (£400) but we have carried out the total as in the report, as it is impossible to tell which of the items is wrong.

There will next appear a statement of the assets and liabilities of the Company on the 31st of October last, and conclusions as to the financial position of the Company as shown on the balance sheet.

The Factory has cost	£77,379
The Capital is only	60,000
The establishment of the Factory has led them to an excess of expenses of	17,379
Which after deducting profits	1,659
Is reduced to	£15,720

This excess of expenditure has caused us necessarily to incur debts, of which the following is a condensed statement:—

Our Mortgage debt (paid up to 31st October)	£11,320
Total amount of trade and other debts owing (up to 31st October)	18,867
	£30,187

From which must be deducted the following assets:—

Cash on hand	£2434	
Balance of divers shipments to France not yet sold	1,157	
Syrup and rum in warehouse	539	
General stores in warehouse, as per inventory 31st October	3,750	
Small bills and acceptances	62	
Accounts owing	1,174	
Advances to Planters	5,351	
		14,467
Showing deficit as above		£15,720

SPECIMEN RUATAN CANE.—While in New Orleans, recently, we saw at the office of an importing fruit company, on St. Peter's street, near the square, a stalk of sugar cane which had been brought from the island of Ruatan, which would astonish the oldest Louisiana sugar planter. It had cut thirteen feet six inches for the mill, had forty joints, and was of monstrous size. Unfortunately, we could not learn the weight. Notwithstanding the size attained by canes in Central and South America, we learn that the yield of sugar is proportionately much less than in Louisiana.—*Louisiana Sugar Bowl.*

THE FRENCH SUGAR DUTIES.

Our readers will not have forgotten the *Projet de Loi*, respecting the sugar duties, which was brought forward by the French Government last December, with the view of bringing the French system of duties into accord with the principle of the Convention of 1864. This *Projet* has been in the hands of a Commission for many months, and now nothwithstanding the anticipated meeting of the Convention of the Four Powers shortly to be held in London, the Report of the French Commission has been presented to the Chamber of Deputies, but there is no probability of its becoming law before some conclusion has been arrived at by the Convention.

The Report of the Commission, as under, is from the *Journal des Fabricants*.

PROPOSAL OF THE COMMISSION.

Article 1.

From the promulgation of the present law the duties on sugars shall be as under (comprising the [additional] five-tenths) per hundred kilogrammes.

Descriptions of Sugars.	Return in Sugar refined for export.	Duty per 100 Kilogrs.	Per Cwt.
Refined { Candy	.. ..	79 francs, about	32/2
Refined { Loaf	.. ..	70·50 ,,	28/6
Above No. 18	96 per cent.	67·78 ,,	27/6
From Nos. 15 to 18 inclusive	94 ,,	66·27 ,,	27/-
,, 16 to 14 ,,	88 ,,	62·04 ,,	25/4
,, 7 to 10 ,,	80 ,,	56·40 ,,	23/-
Below No. 7	67 ,,	47·235 ,,	19/2

Article 2.

Cane sugars imported from countries beyond Europe by foreign vessels are freed from the *surtaxe* of the flag.

Beet root sugars originally from countries parties to the Convention of 8th November, 1864, and cane sugars from ports of the same countries are all free from the *surtaxe* of the port.

Article 3.

Sugars above No. 18 shall be admitted to the benefits of temporary admission, and will be able to share in exportation after refining, to commence any time the Government may fix.

Their return after refining must not be less than 97 per cent.

Article 4.

There shall be placed in every sugar factory for the use of the *fabricant* and in care of the Chambers of Commerce in the sugar producing departments a series of types established by this present law in consequence of the Convention of 1864, which the public will be able to consult.

These types shall be renewed in the month of May, of each year, under the direction of the Minister of Finance and under the oversight of the Ministers of Commerce and Agriculture.

The latter shall appoint a Commission to prepare these types, which shall be thus composed—one *fabricant* of raw sugar producing *Poudres blanches*; one *fabricant* of raw sugar who boils in the open; one refiner from a port; one refiner of Paris; one representative of the Colonies; two sugar merchants; and two sworn sugar brokers from the Bourse of Paris.

Article 5.

Whenever there is any difference of opinion between the administration of the Customs or indirect taxes, and the taxpayer, on the classing of the sugars which by their colour form the extreme limit of each of the classes named in Article 1 of the present law, respecting which recourse to a valuer shall be demanded, the commissioned valuers instituted by Article 19 of the law of the 27th July, 1822, shall to correct their judgment, and as a means of control alone, have recourse either to chemical analysis or to the saccharometer.

Article 6.

All the arrangments of the law of the 7th of May, 1864, those of the Convention of the 8th of November of the same year, and also those of the Declarations of 30th November, 1868, not modified by the present law are maintained in the form and purport.

M. PAYEN.

We extract from the *Journal des Fabricants de Sucre* the following passage from a eulogium pronounced on M. Payen, at the opening of the present course, by M. Aimé Gerard, who succeeded that eminent chemist in the Chair of Industrial Chemistry, of the *Conservatoire des Arts-et-Metiers*:

"Few persons are at present ignorant of the important part which is taken by animal charcoal in the manufacture and refining of sugars. It is well known that by contact with this substance the saccharine juice is purified and decoloured, and that without its aid it would be impossible, now at least, to obtain those superior white and crystallized sugars, which satisfy the eye as well as the taste. But how few are aware, that when the European sugar industry was originated, animal charcoal had not come into use. Chemistry had long shown the decolouring power of wood charcoal, but that of charcoal produced by the calcination of bones was unknown; neither the one nor the other had been used in the sugar industry. It was in 1809 that a skilful refiner named Gullion thought of applying the decolouring action of wood charcoal to the purification of saccharine juices; he thus produced some white syrups of pleasant taste for which a demand for consumption immediately arose. Two years later, in 1811, Figuier of Montpellier first called the attention of *savants* to the properties of animal charcoal which he proved to be far superior to those of vegetable charcoal.

M. Payen then manufactured sal ammoniac at Grenelle by calcining animal matters principally bones, in a closed vessel. In the corners in which till then he had been accustomed to leave as useless residue a mixture of calcareous substances and of separated carbon, that which preserved the original form of the bone was really the product generally known by the name of animal charcoal. It was this product that M. Payen first conceived the idea of applying to the decoloration of sugar. Success did not at first crown his efforts. Either because ill-informed, or from ill-will, the manufacturers to whom he had confided the care of the first experiments did not know how to avail themselves of valuable properties of this charcoal and rejected the use of it. M. Payen was not discouraged. He had already met in M. Derosne a true coadjutor. New experiments were made with marvellous results, and the value of animal charcoal was soon fully established. But still M. Payen encountered great opposition, the use of the new agent was repelled by routine, but at length he conquered it. The Parisian refiners yielded first. Two animal charcoal factories were erected in Paris; but were soon insufficient. A third was erected in Orleans; others followed; and success continually resulting, the use of animal charcoal soon became general not only in France but in all sugar producing, and refining countries."

"The development of this manufacture which owes its existence to M. Payen has followed proportionately the progress of "the Sugar Industry," and now in France alone there are not less than sixty establishments, which, every year deliver a quantity of charcoal representing a total valuo of £240,000."

BARBADOS.

July 9th.—Yesterday, and again this morning early, we had fine showers. The rain sets in late for provisions, but the young canes are healthy and under a good growth. The appearance of the country is very much changed from what it was a few weeks since. The Indian corn is coming up, and the pastures and hill sides are clothed in green. Just now green fodder is in great demand, selling at half a crown the hundred weight. The old crop is cleared off the land, the yield being about one-third less than last year's. There is no telling at present what the next year's is to be. On the whole, the appearance is fair. In some places, particularly the upper part of St. Peter, the young crop suffered from the drought, and had to be replanted in spots when the rains set in. Everything depends upon a continuance of favourable weather for the rest of the year, which the planters look for, because, as they say, they have not had their full share in the first six months, the rainfall not exceeding ten inches. There was a heavy rain yesterday over the town, but it did not extend beyond the limits of the parish, in the direction of Christ Church and to Windward. To-day the fall appears to be general, and to betoken a break up of the changeable weather that has prevailed for the last six weeks. If the rains set in now and keep up they are not too late for the crops. Yams have not sprouted yet, and corn and potatoes are just springing up. Our main stay is the cane crop, and that is sufficiently advanced, and only waits for the heavy rains to quicken its growth. The shipment of produce begins to slacken as the stock on hand diminishes. Only a few vessels remain in the bay or are looked for to load. The shipment of produce to date are 29,856 hhds., 2,414 trcs., 11,520 brls., 5,048 bags sugar, equivalent to 33,536 hhds. 13,705 puns., 704 hhds., 864 brls. molasses. 14 hhds. 9 casks rum.

BRANDY FROM SAWDUST.

In the immense lumber districts of the United States, where the great industry is that which goes on in the saw mills, the sawdust that accumulates is worse than of no value, for some cost has to be incurred in removing it. The Commissioner of Agriculture, in his last published monthly report, states that sawdust may be made to yield under distillation a good article of brandy. Pine and fir timber being the varieties of timber most plentiful in these regions, the method of treating them is described, but it is added that in all probability, many other kinds of wood would prove better adapted than pine and fir to the production of brandy. The sawdust of the pine and fir timber is mixed and moistened; then, to nine parts of moist sawdust there are added 33·7 parts of water and 0·7 parts of hydrochloric acid, so as to make 43·4 parts in all. These are boiled under steam pressure for eleven hours, when it is found that 19 per cent. of the mass is grape sugar. The acid is neutralised by lime, and the mash is supplied with lime yeast. After 96 hours' fermentation the distillation proceeds, and the brandy that runs off is perfectly free from the smell or taste of turpentine. The *Chicago Tribune* remarks upon the statement of the Commissioner of Agriculture, that the preparation of spirit from waste sawdust is actually easier than from valuable grain.

The Price of Coal.—The scarcity and greatly advanced prices of coal cannot but affect the sugar industry, both home and foreign. As it will considerably increase the expenses of refiners, when such contracts as now exist in their favour are ended, they will naturally be disposed to turn out less than their usual working, and this will tend to the continued depression of the raw sugar market. The freight of such sugars as are carried by steamships will be increased to some extent, and the manufacturers of both beet and cane sugars will feel the advance not a little. The manufacture by the simplest machinery will be at the least disadvantage—concrete, for example, which requires little or no fuel beyond the megass for its complete concentration, whilst the cost of producing vacuum pan and charcoal filtered sugars must be greatly enhanced.

MAURITIUS.

(From Licht's Monthly Circular.)

EXPORTS FROM 1ST AUGUST TO 28TH MAY.

	1871-72.	1870-71.	1869-70.
	Tons.	Tons.	Tons.
To England	41,909	17,723	37,339
,, France	13,886	5,931	10,865
,, Australia	27,053	35,886	43,869
,, Bombay	23,704	15,911	29,207
,, New Zealand	3,207	3,522	3,098
,, Cape of Good Hope	1,063	1,903	1,879
,, Other Ports	5,418	696	1,452
Total	116,240	81,572	127,709

HAVANA AND MATANZAS.

EXPORTS FROM THE 1ST OF JANUARY TO THE 1ST OF JUNE.

	1872.	1871.	1870.
	Tons.	Tons.	Tons.
To United States of N. America	122,822	109,471	102,351
,, Great Britain	57,591	43,581	111,274
,, France	10,008	3,270	26,660
,, Spain	21,341	24,495	34,595
,, Northern Europe	8,250	4,016	6,969
,, Southern Europe	183	325	2,205
,, Other Countries	3,323	1,859	3,625
Total	223,518	187,017	287,676
Stocks in Havana and Matanzas	125,390	127,580	145,992

PRODUCTION OF BEET-ROOT SUGAR IN THE THREE LAST SEASONS.

(From Licht's Monthly Circular.)

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
France	327,000	289,083	289,324
Germany (Zollverein)	187,500	262,986	217,192
Austro-Hungary	162,500	182,280	151,354
Russia and Poland	90,000	135,000	132,500
Belgium	73,000	55,739	43,552
Holland and other countries	25,000	17,500	12,500
Total	865,000	942,589	846,422

STOCKS OF SUGAR IN THE CHIEF MARKETS OF THE WORLD ON THE 1ST JUNE, IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	1872.	1871.	1870.
Great Britain	75	127	126
France	55	75	77
Germany (Zollverein)	9	23	9
Holland	42	40	49
Six other Ports	3	.5	4
Stock in Europe	184	270	266
United States of N. America	108	108	126
Havana and Matanzas	125	128	146
TOTAL	417	506	538

CONSUMPTION OF SUGAR IN EUROPE AND THE UNITED STATES, FOR THE THREE YEARS ENDING 31ST MAY, IN THOUSANDS OF TONS.

	1872.	1871.	1870.
Great Britain	704	698	650
France	285	290	303
Germany (Zollverein)	209	214	213
Holland	25	26	30
Six other Countries	104	97	119
Total in Europe	1,327	1,325	1,315
United States	566	497	440
TOTAL	1,893	1,822	1,755

SUGAR STATISTICS—GREAT BRITAIN.

To 20th July, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	21	3	4	23	51	60	44	7	10	39	100	126	35	5	7	23	70	92
British East India	3	..	..	..	3	7	7	3	..	..	10	6	7	6	..	..	13	16
Mauritius	3	1	1	..	4	4	10	4	12	6	32	12	11	3	13	8	35	11
Cuba	2	4	1	12	19	22	1	7	11	25	45	39	3	4	10	19	36	29
Porto Rico, &c. ..	3	5	..	1	9	9	3	10	..	3	16	18	1	7	..	3	11	15
Manilla & Java ..	9	3	..	1	13	31	16	8	2	8	34	29	19	14	2	8	43	40
Brazil	2	9	2	5	18	19	6	31	8	16	61	41	4	29	7	17	57	37
Beetroot, &c.	3	..	..	..	3	14	14	8	4	31	57	101	16	10	5	36	68	100
Total, 1872 ..	46	25	8	41	120	166	100	78	47	129	354	372	96	79	44	114	332	340
Total, 1871 ..	75	38	8	45	46 decrease		121	74	38	139	18 decrease		115	69	35	121	8 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

The raw sugar market has had a downward tendency during the whole of the past month, and prices have given way considerably.

No. 12 Havana is 2s. to 2s. 6d. lower than our last quotations, the nominal price being 28s. to 28s. 6d. per cwt. afloat for the United Kingdom. All other sugars have participated in this decline, and in general, are now about the same price as they were twelve months ago. The average duty paid price of refining qualities of British plantation is 31s. per cwt. Common refined lump is quoted at 40s. 6d. to 41s. in London. Stocks are still considerably below those of last year at this date, but are relatively less so than last month, and it is reported that attracted by the high prices of two months ago, a greater number of cargoes are afloat for this country than is usual at this time of year.

Deliveries up to date are rather below those of a year ago, but this is no doubt chiefly in consequence of many refiners working short time.

Accounts from Cuba confirm the report mentioned last month, that the crop of sugar this season is considerably in excess of that of 1871, and M. Licht's estimate of the great increase in next beet crop is the same as a month ago. As stated above prices have declined to about the same as at this date in 1871, whilst stocks in this country are now 45,000 tons, and together with those in Europe 86,000 tons less than at that period and although the consumption in Europe is nearly stationary, it must be remembered that in the United States it is greatly on the increase. All things considered, there does not at present appear to be any strong ground for further decline in the value of sugar.

THE

SUGAR CANE.

No. 38. SEPTEMBER 2, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

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THE INTERNATIONAL SUGAR QUESTION.

A Conference was opened on the first of August, at the Foreign Office, in London, to consider the question of drawbacks on refined sugar, as settled by the Convention of November 8th, 1864, between the four powers, Great Britain, France, Belgium, and Holland.

The Conference was opened by Earl Granville, and the following delegates were present:—for Great Britain, Sir Louis Mallett, C.B., Member of the Indian Council; Mr. R. A. Ogilvie, Surveyor General of the Customs, and Mr. C. M. Kennedy, Head of the Commercial department of the Foreign Office. For France, M. Ozenne, Secretary-General of the Ministry of Agriculture and Commerce, and M. Amé, Director-General of Customs. For Belgium, M. Fisco, Inspector-General to the Ministry of Finance, and M. Guillaume, Inspector-General to the Administration of Direct Taxes, Customs and Excise. For Holland, M. Uyttenhooven, Administrator-in-Chief of United Taxes to the Ministry of Finance, and M. Joe Water, Provincial Inspector of United Taxes in Southern Holland. To Mr. G. F. Walpole, of the Customs, was assigned the office of Secretary to the Conference, and to Mr. H. W. Austin, of the Foreign Office, the part of Protocolist. The Conference, after some formal proceedings was adjourned to the 3rd of August.

Several meetings of the Conference have since been held, the proceedings of which have not been made public, at least on this side the channel. The *Journal des Fabricants de Sucre* however appears to have received some information on the subject, and in its *Chronique* of the 15th August, it states that the Conference has held many sittings without the question having advanced a step, and without coming to any agreement on the various points under discussion. "If we are well informed" continues our contemporary, "England, with characteristic persistency, has constantly advocated the duty on consumption in which she sees the most equitable conditions, and not merely the safeguard of the interests, but even the very existence of her refineries. Holland, which has so largely profited by the Convention of 1864 in the increase of her export trade in which she is the rival of France, in nearly all the markets, is not in favour of refining in bond, assigning as a reason the difficulty of its application. She wishes to examine every other system proposed before agreeing to adopt this; still, however, she will give way to the majority. The strongest opposition comes from Belgium, and from the representatives of the French Government, who, deaf to the general opinion, are convinced that the ingenious system of correlation of duties which they now propose to carry out faithfully as the result of their imprudent engagements in 1864, is the true solution of the sugar question. The Conference has adjourned under these circumstances without fixing any date for its next meeting."

No doubt the French sugar *fabricants* and their representatives in the press are universally in favour of refining in bond. As was mentioned in a foot note to an article in the last number of *The Sugar Cane*, the *Conseil Superieur d l'Agriculture, du Commerce, et de l'Industrie*, reported by a majority of 13 votes to 5 in favour of refining in bond. The following is a translation of the exact text of their minute:—" The *Conseil*, in approving the modifications proposed by the Commission, would prefer refining in bond, and duties payable on consumption, should the system be accepted under satisfactory conditions by the other Powers parties to the International Convention, as it would ensure most certainly the just assessment of the duties on sugar and its exact collection."

The assertion that many of the Belgian *fabricants* were opposed to the conclusions arrived at by the Congress, held at Brussels, the 17th and 18th of last April is not supported by facts. A petition, it is true, was presented to the Belgian Minister against refining in bond, &c., but this was only signed by a very few individuals.

The Council of the Association of Belgian sugar *fabricants*—which represents seven-eighths of the whole number in Belgium—has disclaimed all sympathy with this opposition, in a letter signed by the President, Baron de Lafontaine, and the Secretary, Jules Cartuyvels, of the date of the 10th of April, and which appears in *La Sucrerie Indigéne* of the 20th. The letter states emphatically, that with very few exceptions, at most six, out of ten times that number, the Belgian sugar *fabricants* are in favour of the decisions of the Congress, and that the note of opposition has found a very feeble echo; in fact, the result has been to show how nearly unanimous, and how strong is the feeling of the Belgian sugar industry in favour of *l'impot, à la consommation.*

Soon after the opening of the Conference, delegates from the *Fabricants de Sucre* and from the *Societié des Agriculteurs* of France waited on the Minister of Agriculture, with the view of informing him of their dissatisfaction with the attitude of the representatives of France in the London Conference. They were cordially received by M. T. de Bort, and the offer was made to request the temporary return of one of the delegates from London, that he might hear the observations of the remonstrants. After their conference with the minister the delegates entertained hopes that the views unanimously expressed by the Sugar Manufacturers, by the Society of Agriculturists of France, by the Central Society of Agriculture, and especially by the Superior Council of Commerce after a long and laborious inquiry, would have due weight with the French representatives at the Conference.

If it be true that England, as represented at the Conference, was strongly in favour of refining in bond, which there seems little reason to doubt, the agitation of the question cannot but have been of service; and the beet growers and *fabricants* of both France and

Belgium being united in holding the same views, it is scarcely possible that the French and Belgium Governments can long be content with things as they are.

IMMIGRATION INTO JAMAICA.

Some time ago accounts appeared in this magazine respecting the efforts which were being made to increase the immigration of Coolies into Jamaica, where labour is very scarce. A copy of a paper on the subject has been forwarded for publication in *The Sugar Cane*, and will be found of considerable interest to numerous readers:—

The Immigration of Maltese Labourers into the West Indies.

During the years 1868 and 1869 I was stationed in Malta, and for a great part of the time was Commandant of the Sanitorium at "Citta Vecchia," situate in the centre of the Island, and surrounded by plantations for the cultivation of cotton, olives, &c., and famous for the production of corn, vegetables, and fruit.

I had consequently many opportunities of observing the labouring people of the contiguous districts—whilst at work, and of making myself acquainted with their attributes, manners, and customs; and happening one day to mention, in the hearing of a gentleman, the head of a shipping agency of long standing in Malta, that I thought the people would make excellent labourers for the West India Islands, and that in consequence of the very evident state of over population existing in the Island, there could be little doubt but that many might be spared from Malta, this gentleman informed me that in the year 1837, the owners of the estates Oxford and Eden, in Jamaica, made an effort to obtain 200 labourers in Malta for those estates, and had met with most signal success, as the placards and bills containing the terms of contract, &c., had scarcely been issued, when the people began to apply in large numbers, and in less than three weeks the agent had more than 500 applicants to select from. The labourers were not shipped at this time in consequence of an order having been promulgated by the Home Government, prohibiting indented labourers of any kind being introduced into the West India Islands. But as this order has since been rescinded, and perceiving that the want of labour in Jamaica, is now as great as it ever was, I was induced to write to friends in Malta to enquire whether, in their opinion, if a call for immigrants for Jamaica were now made there, it would be as readily responded to as in 1837; and the replies I received were so decidedly and entirely in the affirmative that I considered it my duty to make them known in the proper quarter; in furtherance of which object I wrote a letter to the Acting Agent General of Immigration, embodying the facts which I had obtained from Malta, and to that letter I received a reply to the effect that the Governor thanked me for the information afforded by me, which His Excellency "thought very interesting, and that any planter "who considered that an importation of Maltese labourers would be "for his advantage, might, the Governor believed, introduce such "labourers, under a contract of service not exceeding three years, "under the provisions of 22 Vic., cap. 6, provided that the port of "Valetta had been previously sanctioned as a port from whence "immigration into this colony shall be permitted; but Government "had no power to institute an immigration system from Malta."

In view of the opinion of His Excellency I have drawn up the annexed paper for circulation, as far as it may be within my power, amongst the planters and other employers of labour in Jamaica, trusting that the facts therein set forth may eventually, if not at the present time, prove of service to them and to the country at large, by drawing attention to a mart whence, in the opinion of many persons competent to arrive at a sound judgment on the subject, a continuous supply of labour of a description admirably suited to the wants of this colony may be drawn for many years to come, if not in perpetuity.

Signed, W. A. DOORLEY,
Int. Rev. Depart. (late 24th Regt.)

The first question of importance which arises in considering the subject of the introduction of a new class of immigrants into any country is the suitability of its climate; and it will be well to note any similarity which may exist on such an essential point, between the country whence the immigrants are being taken and that to which they are about to be introduced.

The climate of Malta is intensely hot during several months of the year; and although it becomes cooler in the winter months, the mean yearly temperature is not much lower than that of the table-lands of Jamaica, and other West India islands; and the Maltese labourer may be seen in his own country working in heat the intensity of which is scarcely equalled in any other part of the world.

The Maltese are mainly an agricultural people, and the island is highly cultivated, its principal products being cotton and corn (*vide* "Col. Off. List, 1872.") They are also good farmers and expert gardeners, and are careful in tending animals. As a people, they are honest, industrious, hard-working, and extremely sober, and, according to the opinion of the late Sir John Burgoyne, who had many opportunities of arriving at a correct judgment, "always conspicuous for energy in their labour."

The Maltese are, as a rule, strong and well built, possessing good muscular development, and considerable power of endurance under long and trying physical strains.

There is every reason to believe that the Maltese would now be found equally ready to emigrate in considerable numbers, as in the year 1837. For years past large numbers have been emigrating to Barbary, Egypt, Smyrna, and other places in the Mediterranean, without guarantee of any kind, and it is thought by gentlemen in Malta, whose opinion on the subject I have taken, that many of these emigrants would return to Malta for the purpose of securing to themselves the certainty of steady and remunerative employment, such as would be offered them were the scheme now proposed, to be carried out.

It is considered by the before named gentlemen that any scheme which would tend to relieve Malta of a portion of its greatly superabundant population would be sanctioned and warmly supported by the Government of that island, and as far as the people were concerned, more could be obtained than would be wanted.

A comparison of the population of Malta with that of Barbados, another island well known to be overpopulated, will give a fair idea of the extent of the overpopulation of the former place.

By the last Census it was shewn that in Malta there were over 1,400 inhabitants to each square mile, whilst in Barbados there were but 914, and in Jamaica there were but 69. Thus it may be seen that in Malta there are nearly 500 persons to each square mile more than in Barbados.

With respect to food; that of the labouring classes in Malta consists principally of such ingredients as can be procured in the West Indies, and at first there would be no difficulty in importing with the immigrants, such quantities of the food to which they are accustomed—that is, olive oil, maccaroni, &c. (all of which are extremely cheap in Malta), as would last until they had acquired a taste for the food of the West Indies.

The terms under which the immigrants might be expected to engage would be similar to those now stipulated for on account of the Indian immigrants by the Government of Jamaica, (or which in my opinion would be still more suitable than those set forth in the Jamaica Immigration Acts, 25 Vic., cap. 5—22 Vic., cap. 1—and 22 Vic., cap. 2) the laws relating to Chinese immigration, which might with very little alteration be made applicable to Maltese immigration.

It has been estimated that the expense of introducing Maltese immigrants into Jamaica would be about £6 for each adult, and for each child from £2 to £4; and that the return passage of such as should elect to go back to Malta at the expiration of their indentures would cost about £4 for adults, and from £1 to £3 for children. This sum might be otherwise appropriated in being given as a bonus to those who should agree to remain in Jamaica.

It will thus be seen that the whole cost for each adult immigrant will be about £10, and the cost for each child from £3 to £6.

It has been proposed that these sums be met by the parties requiring the labourers in the following manner, viz. :—the sum of £5 to be paid to the agent in Jamaica for each adult labourer on allotment, and for each child capable of performing field work the sum of £3; and the employer of every immigrant shall further pay in advance for every year's service of each adult immigrant the sum of £1, and for every year's service of each child as aforesaid the sum of ten shillings. The age at which a child would be deemed fit for field labour could then be settled. It is supposed that were these immigrants introduced into this colony, not many would desire to return to Malta at the expiration of their indentures, as the facility with which land may be acquired here, and the many other advantages they would possess beyond those attainable in Malta, would induce a feeling of contentment, and prevent their returning in any considerable numbers to their own country.

Mandeville Jamaica,
10*th June*, 1872.

A NEW REAGENT FOR THE PRECIPITATION OF LIME IN SATURATED JUICE.

By Ch. Henry Bassett.

From La Sucrerie Indigène.

I have before called the attention of chemists to a valuable property possessed by normal phosphoric acid, that of precipitating caustic lime only, even in a liquid containing this earthy base under two forms, free and saline, a property which makes this compound the special reagent for testing lime eliminable by carbonic acid, and thus facilitates the progress of the operation of gasifying the defecated juice.

As the season will soon commence, it seems particularly desirable that I should complete the subject by the addition of some important details.

It will be useful to go over some of its reactions again briefly, so as to render familiar the particular precipitate which is formed when free or eliminable lime is present, and which differs from the alkaline phosphate which is produced in a liquid holding salt of lime in solution.

1. If phosphoric acid, trihydrated or normal is thrown into a calcareous sugar solution, voluminous, semi-transparent flocks of lime are precipated, detached rather than in masses, if care is taken not to agitate the liquid.

2. An excess of phosphoric liquor dissolves the precipitate which has been formed in the preceding operation. We shall see further on, the part which this solubility of the precipitate in an excess of liquor, will enable us to take.

3. If we throw this phosphoric liquor into a solution of any calcic salt whatever, such as nitrate, chloride, sulphate, aspartate, malate, citrate, tartrate, bicarbonate, glucate, &c., &c., no change will take place.

4. Added to a mixture of lime salt and free lime—such as is the defecated juice of the beetroot—the phosphoric liquor forms a characteristic flocculent precipitate of uncombined lime, a precipitate which an excess of the reagent dissolves very easily, as in No. 2.

5. The phosphates of potash, soda, ammonia, added to some solutions of lime salt, engender the formation of a gelatinous precipitate, which soon becomes divided into very tenacious small flocks, of quite different appearance from that which is formed by phosphoric acid with free lime.

6. Although this reagent (normal phosphoric acid) may be inactive when in contact with lime salts, it is evident that it will act if the liquor contains alkaline oxides, potash, soda, or ammonia; there will be formed alkaline phosphates, which will act by double decomposition.

7. I have stated that to prove the presence of free lime it will be needful to employ the combination known as trihydrated phosphoric acid, which may be considered as the normal phosphoric acid, and not the other hydrates, called metaphosphoric or pyrophosphoric acids; the first of which is a monohydrate, and the second a bihydrate.

8. The precipitate obtained in the presence of alkalis, that is to say by double decomposition, is soluble in an excess of the reagent, the same as that obtained with free lime.

The calcic combination which we use for these reactions is the glucate of lime, perfectly devoid of free lime. This compound is very easily obtained by a solution of sugar inverted by oxalic acid, which is treated with an excess of hydrate of lime. It is then sufficient to filter and afterwards to carbonate thoroughly the brown liquor which results from it in order to transform the excess of free lime into bicarbonate, to decompose the soluble acid carbonate by a sufficiently prolonged boiling, and again to filter.

If it is wished to have an uncoloured calcic solution it will be needful to boil some grammes of asparagine with a slight excess of lime, to carbonate completely, then to carry to ebullition and filter as before; there will thus be obtained a solution of aspartate of lime very suitable for repeating the experiments above mentioned.

Preparation of the Phosphoric Liquor.—Nothing is more simple and easy than this preparation, as it is sufficient to dissolve in distilled water, or even in ordinary water, some crystals of the glacial phosphoric acid of commerce, afterwards to dilute this solution so as reduce the density to 1·007, or 1° of Baumé's areometer.

Thus prepared this reagent should produce, in contact with sucrate of lime, the precipitate characteristic of free or caustic lime, and also cause no precipitate in a solution of glucate or aspartate of lime. Neither should it precipitate chloride of barium.—Neutralised by soda or potash it should produce a yellow precipitate in nitrate of silver. It is very important to be certain that the phosphoric acid, which is used as a re-agent, should be free from metaphosphoric acid, which would have the effect of falsifying the indications by precipitating lime salt. The metaphosphoric acid may be recognised by the following characteristics:—

1. Treated with neutral nitrate of silver it causes a white precipitate.

2. It will also precipitate chloride of barium.

3. It coagulates albumen at the ordinary temperature. A solution of albumen may easily be procured by allowing the white of egg to stand in a little water, and then passing the whole through linen. This solution will serve as a test for metaphosphoric acid.

These trials, so easy to make, should not be neglected, because it is very easy to receive, as has happened to myself, monohydrated phosphoric acid instead of the normal acid. It may be recognised in dissolving the crystals in water, as when they come in contact with it a crackling is observed; also by their dissolving slowly. When the characteristics of monohydrate have been recognised in the acid, such as the precipitation of chloride of barium, of nitrate of silver, and coagulation of albumen, it may be transformed into the trihydrate by boiling for a long time, always taking care to replace the evaporated water; it may be withdrawn from the fire, when it will no longer cause the reactions cited above.

All this trouble may be avoided by purchasing *syrupy phosphoric acid*, which is certainly trihydrated.

Use.—The employment of this reagent for the purpose of proving the presence of lime, does not necessitate any other apparatus than some small filters, and even very often it is sufficient to allow it to settle for an instant to clarify the liquid. This permits the production of the flocculent precipitate to be seen, the more voluminous, as the proportion of lime is greater. The experiment is very easily made in a test glass.

When the operator is obliged to distinguish the precipitate produced by free lime, from that resulting from double decomposition, after two or three experiments made with known liquors and in the manner indicated, it soon becomes a work of rapidity.

It is not needful to consider further the precipitate formed in the presence of alkalis, as the only end in view is to prove that the lime is amenable to carbonic acid gas, and the less so, as we have seen the precipitates differ in appearance.

As to its sensitiveness, this reagent is valuable, because of the absolute insolubility of the precipitate which it forms, the bone phosphate of lime.

Average Proportion of Lime to the Phosphoric Acid.—I have thought that we might partly judge of the proportion of lime from the solubility of the precipitate of the bone phosphate, in presence of a slight excess of phosphoric acid, and I am sure that this operation, more empirical than scientific, but nevertheless industrial may be realized.

With this aim I took 3 c.c. of a solution of sucrate of lime, containing 0·0088 grm. per c.c. of this base; it afterwards required 9·9 c.c. of the reagent to re-establish the limpidity of the liquid. In another case I took 10 c.c. of the same sucrate, and the limpidity this time was established by 33 c.c. Thus we see that the operator may not only be assured of the absence or presence of free lime, but may also determine the proportion.

As to the instruments which this method of determination necessitate, they are reduced to two: one burette to contain the phosphoric liquid previously standardised, and one flask of elongated form, with ground lip, similar to a foot burette, and having upon it a scale divided into cubic centimetres so as to be able to measure 50 c.c. at once.

Provided with these instruments, to which must be added a small stock of filter paper, the operator will take some juice from the pan, throw it into the filter placed above the flask, into which he will introduce 50 c.c.—that is to the guage mark, of clear liquid; to this he will afterwards add the calcimetric liquid by small quantities at a time; he will thus obtain at first a precipitate more or less voluminous; after each addition he should shake the flask as in various other experiments, and should repeat this until the precipitate has entirely disappeared, after which by the aid of a small table calculated on the richness in lime, proportioned to 1 c.c. of liquid acid, the proportion of caustic lime in a hectolitre of the juice assayed, would easily be calculated.

As regards the standardising of the phosphoric acid, I may state, that it is quite sufficient to have on hand a solution of sucrate of lime of which the exact proportion of anhydrous lime is known, and to ascertain by two or three experiments the quantity of acid necessary to produce the perfect limpidity of the liquid. After this a table should be calculated. I may add that it is better to prepare a considerable quantity of the phosphoric solution at once of the proper standard, in order to save time, as this liquor will keep for a long time without alteration.

The defect of the phosphoric acid thus applied to the determination, is that it produces double decomposition owing to the presence of considerable quantities of alkalis in the juice. It may, however, be possible to find means of correcting this defect.

To conclude, the phosphoric acid affords a means of rapidly ascertaining the presence of free or caustic lime in the juice ; it does not permit, it is true, the very exact determination, but rather approaching that which is based on alkalimetry.

For want of trihydrated phosphoric acid, recourse may be had to tartaric or citric acid, which have in common with the first, though to a much less extent the property of precipitating lime, not salt. But these acids are much less sensitive than our reagent, because of the solubility of the calcic salts which are formed by them. The sensitiveness of the phosphoric acid compared to that of the two other acids, is nearly in the relation of one to ten.

LEEWARD ISLANDS.

The rains which fell in July, and which gave promise of the breaking up of the drought, have not continued; in fact, in Antigua, the drought has returned, and the windward side of the island is suffering greatly. The ratoons on the hill sides, grown by the negroes, have failed to a great extent. The plant canes on those estates which have been cultivated by the steam plough are generally in much better condition than the rest ; it has been almost impossible to turn up the soil with cattle ploughs in some parts. The crops have proved quite as small as was anticipated.

Information has been received from Antigua just before going to press, to the effect that about half-an-inch of rain fell in some parts of the island on the 12th of August.

The concrete on the estates on which Concretors have been in operation in this island, has, on being weighed, been found to average 1·98 lbs. per gallon of cane juice during the season.

PROSPECTS OF THE BEET-ROOT ON THE CONTINENT OF EUROPE.

The following information is chiefly from the *Journal des Fabricants* of the 22nd:—

The beautiful weather of last week has continued now for twelve days; we have enjoyed a very propitious time for the beet. The heat and the dryness do not come amiss after the, so to say, uninterrupted rains, and we may hope that this change will prove favourable to the saccharine richness of the plant hitherto undeveloped.

If we go back to last year we find that after a short dryness at the beginning, the beet received a deal of rain up to and in the first week of May; the remainder of the month was a very dry time and the beet required rain. The month of June was rainy and cold as well as the first half of July. From this date, and during part of the month of August there were intermittent seasons of great heat and rain which caused the beet to grow vigorously, but was not favourable to the production of sugar.

We do not yet know what will be the result of this year. The beet-root will have had the advantage of slow but regular vegetation at the commencement, the rainy period having never been interrupted. The results of analyses which have been forwarded to us augur well for the quality. With beet-roots varying from 555 to 1250 grammes, taken from different fields, showing a density of from 4·7 to 5·8, nothing is wanting but continued dry weather. There is a probability of the beets being rich, but it is important that from the present time to the middle of September the rain should not be abundant.

In certain parts of Belgium, and in Southern Germany appearances are as favourable as in France, but in Northern Germany where the beet is most largely cultivated, there are great complaints of the premature and intense dryness which is unfavourable both to the quantity and quality of the beet. In Austria the crop promises to give magnificent results, and it is estimated that there will be an excess of 75,000 tons, which will be available for exportation.

The following is M. Licht's estimate of the next season's yield:

Estimate of the next Season's Beet Sugar Crop on the Continent of Europe, compared with the two previous seasons.

(From Licht's Monthly Circular.)

	1872-73. Tons.	1871-72. Tons.	1870-71. Tons.
France	350,000	327,000	289,084
Germany (Zollverein)	250,000	187,500	262,986
Austro-Hungary	175,000	162,500	182,280
Russia and Poland	135,000	90,000	135,000
Belgium	80,000	73,000	55,739
Holland and other countries	35,000	25,000	17,500
Total	1,025,000	865,000	942,589

Drawback on the Export of French Chocolate. — The French Government issued a decree, some time ago, granting a drawback on the export of French chocolates, proportioned in amount to the quantity and quality of the sugar which has been used in the manufacture of the chocolate. The first two articles of the decree will show its scope.

Art. I. Cocoa and sugar imported in French ships, as well as home made sugar, intended for the manufacture of chocolate, may be admitted free of duty, temporarily, under the conditions of the Article V. of the law of July, 5th, 1836.

Art. II. The importer will engage, by substantial security, to re-export or return into the bonded warehouse within four months, 100 kilogrs. of chocolate for 53 kilogrs. of cocoa and 60 kilogrs. of raw sugar of the numbers 10 to 14.

The above numbers D.S. are taken as a basis; of lower sugars more may be used, of sugars of higher numbers less; in proportion to the Convention standards.

BEET SUGAR IN CALIFORNIA.

Mr. Charles Nordhoff, a correspondent of the *New York Tribune*, writes to that paper, from Sacramento, as follows: "The Sacramento Beet Sugar Company have expended, in buildings, machinery, and 540 acres of choice land, 225,000 dols. They have rented other land, so that they have sown with beets, this season, 1,100 acres, from which they hope to get an average of 10 tons of beets to the acre. In France they get from 12 to 15 tons to the acre; in England, it is reported, they have got 18 tons to the acre. At Chatsworth, in Illinois, and also in Wisconsin, I believe they got but 10 tons to the acre. I am satisfied that the methods of culture can be improved in California. Deep ploughing is hardly understood, as yet, in this State; and thus the real wealth and producing power of the soil are not utilized. But the beet here yields—so the managers told me—a much larger per centage of sugar than in Europe; and with the favourable climate and rich virgin soil, this does not surprise me. The field culture and general work of the farm are done by Chinese labourers. The manager has perfected a seed-sower which sows twelve rows at once, and is believed to be an improvement over all machines used for this purpose hitherto. The seed this year came up very evenly and regularly, and of course this is an important advantage. The beets are thinned in the rows, weeded, and dug by hand. In Europe a digger is used; but this has not yet been introduced here. The Chinese, who work in gangs, each gang under a leader chosen by themselves, receive 5 dols. per week. For this they feed themselves, the Company paying a cook for every 30 men. They furnish, also, their own bedding and cooking utensils, and are lodged in very cheap shanties, the climate making substantial houses for them needless. The 1,100 acres planted this year will employ the factory about eight months, and the manager hopes to turn out at least 10,000 barrels of sugar this year. Only the whitest sugar is made. A ton of beets ought to yield, I am told, a barrel of sugar.

ON THE INFLUENCE OF FORESTS ON RAINFALL.

BY ALFRED FRYER.

(Continued from page 424.)

"It may be asked how these views can be reconciled with the case mentioned by *Boussingault* as having occurred at Marmato, where, notwithstanding the cutting down of the woods, the rain in one year was above the average; and where, notwithstanding this increase of rain, the principal stream of the district showed no increase, but, on the contrary, went on diminishing. The observation, as *Boussingault* says, extended over too short a period to afford any safe basis for correct conclusions. But the facts are not inconsistent with the general laws before explained. *Boussingault* does not say that a local and partial cutting down of forest will always produce less rain. To produce such a result, he distinctly says, that the felling of the forests must be 'over a *large* extent of country.' Then as to the circumstance that more rain should fall than usual in a district, without producing any increase in the stream of that district uncovered by wood, an explanation is afforded by the large amount of evaporation which takes place when the surface of the district is exposed to the joint action of the sun and the wind.

"On this subject of evaporation, an interesting report, by *Mathieu*, has recently been published by the French Government, prepared by the orders of the General Superintendent of Forests, *Mathieu* himself being one of the directors of the Imperial School of Foresters. One of the many points investigated in this report was, the evaporation from land covered by wood, and land clear of wood, respectively. It appeared, that during the seven months comprised between April and October, 1867, whilst the quantity of water evaporated from forest land was 3·23 inches, the quantity evaporated from land clear of forest was 16·29 inches, or about five times as much.

"In April, before the development of leaves, if 1000 represented the evaporation from the open country, 623 represented the evaporation from woodland; but after the trees became clothed with foliage, the amount of evaporation from the woodland was only 130, as against 1000 of open country evaporation. In October, the woodland evaporation was to the open country evaporation as 90 to 100.

"The important bearing of these figures cannot well be overstated. What is the quantity of moisture which soil, kept moist, loses by evaporation, when exposed to the sun and wind. *Halley* found that when water was kept in a room, to which neither sun nor wind had access, the evaporation amounted to 8 inches in a year; but when exposed to sun and wind, even in the cloudy atmosphere of London, it amounted to 48 inches yearly. More recent and accurate observations make the natural evaporation from soil kept moist not quite so much. *Howard* of London gives, as the mean of eight years' observations, 30 inches. *Dobson* of Liverpool found, after four years' observations, a mean annual loss by evaporation of 37 inches;—the least evaporation being in December, when the temperature was 44°.—the greatest in July, when the temperature was 70.° *Dalton* of Manchester found that evaporation there was at the rate of 30 inches,—the lowest being 1·01 inches, in December; the highest 4·09, in July.

"An instructive table was framed by *Dalton*, showing the number of grains of water evaporated, from a given surface and during a given period, at different temperatures, and with different velocities of wind. The following extracts are made from this table:—

Temp. Faht.	Light Wind.	Strong Wind.
50°	1·50	2·36
60°	2·10	3·30
75°	3·40	5·34
80°	4·0	6·29
85°	4·68	7·46

Therefore, if in England, with an average annual temperature of 50°, the quantity of water evaporated from moist soil is at the rate of 38 inches annually (the mean of the foregoing observations), what must the evaporation from soil moistened by rain at Malta be, where the mean annual temperature is 67°, and where there are violent gales, the force of which there is nothing to break? The table shows that the number of grains evaporated at a temperature of 67°, would be 2·16 with a light breeze, and 3·38 with a strong breeze, being in either case about one-half more than the evaporation in England. In other words, if 38 inches represent the mean annual evaporation of moisture from open moist soil in England, 57 inches would represent the quantity which would be evaporated from open moist soil in Malta. But clothe the island with wood, and the surface, wherever so protected, would evaporate at the rate of only 11 inches, according to *Mathieu's* observations. Now, on the principle that a penny saved is a penny gained, these results are equivalent to an addition to the annual rainfall in Malta of 46 inches (57—11); that is, on those parts of the island covered with wood.

"The case has not been even so strongly put as it might be, because no account has been taken of the fact that in Malta the general surface consists mostly of rock, with no covering of soil; and as rain, when it falls, will not penetrate as far into the rock as into porous soil, the figures on *Dalton's* table, when modified to suit the soil of Malta, would give a larger rate of evaporation.

"Reference has been made to the frequency of floods and inundations, in countries cleared of forests. The rain, when it falls on woods, is broken in descent by the leaves and branches, so that it reaches the ground with diminished force. Moreover, when it reaches the ground, it finds a mass of soft, decayed vegetable matter, which, like a sponge, retains the water, and allows it to percolate slowly towards the lower grounds. When the land is uncovered by forests, there is no such sponge. The rain-drops, falling on the surface with full weight, at once cut into the soil, and form in it torrents, so that the rain-water, instead of remaining for a time on the land and on the soil to supply vegetation, rushes off to the sea, without imparting any of its natural benefits to the country where it falls. Another evil arises. An immense amount of damage is done to machinery and other property by these inundations, and large quantities of valuable soil are carried off and lost. Where forests exist, the soil is protected, not only by the spongy layer before adverted to, but by a matting of tree-roots.

"The next point deserving attention is the action taken by the governments of different countries in reference to this matter. That action shows a strong conviction on the part of these governments, of the evils arising from the destruction of forests, and of the necessity, in the interest of the public, of providing a remedy.

"France, from a very early period, appreciated the value of forests. The illustrious *Colbert*, Minister to Louis XIV., had a voluminous code of laws drawn out in the year 1669, applicable not only to the forests of the State, but to those of proprietors, who were forbidden to cut down trees, except on certain conditions. At the time of the Revolution, when it seemed to be thought that every one should be allowed to do as he liked, all these restrictions were abolished. Proprietors could cut down all the trees on their estates, if they chose; and the State forests were given up to general plunder. But not many years elapsed before the grievous errors committed in this matter were admitted. In April, 1803, prohibitions were again introduced, to restrain proprietors from ruthless extermination of trees, and also to protect the State forests.

"Notwithstanding these prohibitions, it was found that enough had not been done. Many springs, and even streamlets, which were known to have been formerly unfailing, now failed altogether, or appeared only during a rainy season; whilst, on the other hand, rivers when in flood rose to unusual heights, doing damage to arable land, and great injury to mills and manufactories.

"One of the reports on this subject came from the Forest Commissioners in the year 1827. It was addressed to the Chamber of Peers, and contained the following passage:

" 'The denudation of the hills excites everywhere universal complaints. The sterility by the carrying away of the vegetable earth which was retained by the trees, the diminution of springs, the formation of torrents, which overwhelm properties,—these are the consequences of the wood-cuttings made in elevated places; and it is against these denudations that the administration should arm itself with severity.'

"The complaints of the manufacturers and of all classes at length became so urgent that the French Government employed the most competent men of science they could find to investigate the subject; and hence the number of treatises which appeared shortly thereafter by such distinguished men as *Clavé*, *Boussingault*, and others. The subject more recently came before the French Legislature in 1859 and 1860, when two ordinances were passed, the object of one being to enact much more stringent restrictions as to the cutting down of trees before reaching maturity, and the other to encourage Proprietors to extend the area of planted land on their estates. With this last view, it was agreed that a million of francs annually, for ten years, should be applied to assist Proprietors; and it is a remarkable proof of the general approval by the public of these measures, that the first of these new ordinances was in the Legislative Assembly supported by 264 members, and opposed by only four—the second being objected to by only one member.

"The Italian Government, it is understood, has recently been adopting measures similar to those of France. The author of these remarks, whilst lately in Italy, learnt from an Italian landed proprietor, that certain laws have been passed, requiring proprietors who cut down so many acres of forest, to plant a certain quantity of new ground in proportion. Encouragement is also given to proprietors to sell forest land to Government, on account of the difficulty of protecting forests belonging to individual proprietors. There are in Italy unmistakeable signs, which do not fail to strike even a casual traveller of the evils arising from the destruction of its forests. Only last December, an inundation of the Arno took place, which laid most of the town of Pisa, and the country for many miles around, under water; a great massive stone bridge was carried away, and the water rose so high in the streets, that the inhabitants of the lower storeys had to take refuge in the higher storeys. The only means of intercourse for two days was by boats. There were two large churches, on the floors of which a thick layer of mud was left. In the street leading towards the railway station, which is on rather a higher level than the other streets, the flood had left its muddy mark on the walls of the houses, both outside and inside, to a height of fully ten feet above the street footpath. A most pitiable sight it was, two days after the Arno had sunk within its usual limits, to witness the inhabitants removing from their shops and rooms their furniture, goods, and wares, drenched, smeared, and rendered almost completely useless by three days' immersion in the muddy waters of the river. Now it is to be presumed that, when the churches and houses of Pisa were built, inquiry must have been made by the inhabitants and magistrates as to the heights of the highest floods of the Arno. The fact, therefore, that in December last a flood rose so high that the people would have been drowned in the churches and houses had they remained in them, is a clear proof that this river is subject now to greater floods than in olden times.

"In our Indian Empire, about twenty-five or twenty-six years ago, this subject forced itself on the attention of the different local governments, chiefly in consequence of complaints of an alarming diminution of water supply in the irrigation districts.

"Preliminary inquiries were set on foot, and numerous reports were obtained, which were sent home for the consideration of the Board of Directors.

"One of these reports—by *Dr. Gibson*, dated 9th March, 1846—contains the following passage:

"'In the collectorate next Bombay, all the inhabitants concur in stating that since the tract has been denuded of forest, the springs have left the uplands, that the climate has become greatly drier, the season more uncertain, and the land less fertile. Effects of the same kind have been experienced in the Neilgherry Hills.'

"In the year 1827, the Board of Directors sent a despatch to the Supreme Government, requesting the attention of the authorities to the effect of trees on the climate and productiveness of districts.

"In consequence of these instructions, the Supreme Government of Calcutta issued orders for more detailed information, and employed the ablest men they could find to draw out further reports. These reports having established beyond doubt that evil had already risen to a large extent from the general destruction of forests, regulations were drawn out for the conservation of forests; and conservators were appointed, with numerous inspectors to see that the regulations were enforced.

"To show the character of the reports by which our Indian Government was guided in this matter, the following extracts may be given from one of them:

"'During the whole of my tour in Coorg and Mysore, I have endeavoured to collect information bearing on this important question; and the facts thus elicited go to prove, that a tropical forest is the *alma mater* of springs and streams. Various instances have been brought to my notice of springs and small streams having become quite dry, since the forest was cleared away in their neighbourhood; while in numerous cases, those that used to be perennial, only contain water now, during, and for a short period after, the monsoon.

" 'At the same time, the natives of the district complain that of late years their country has become hotter and drier for want of rain, and that rice crops have been diminished or lost from a failure of water in streams that used to run throughout the year. These changes they attribute to the cutting down of forests for coffee estates.'

"The reporter's own opinion is thus expressed:

" 'That the cutting down of forests in Coorg has rendered both the earth and the air drier, is clearly shown by perennial streams having become periodical, by many plants perishing that used to flourish, and by other remarkable changes in natural phenomena.'

"In a recent Mauritius paper, it was stated that the culture of the sugar-cane had of late become so precarious in the island owing to the excessive dryness of the air, consequent on the cutting down of the native forests, that the Government had appointed a commission to investigate the matter and suggest some remedy. The commissioners' report entirely confirmed the prevailing impression, that streams once unceasing and copious were gradually drying up, and that the cause was to be found in the constantly diminishing area of forest land, in order to bring more land under cultivation. What the resolution of the Mauritius Government has been, is unknown to the anthor of these remarks; but in the report by the secretary of the island, he suggests whether, besides carefully preserving what remained of the forests, 'the Guardian of the Woods and Forests should not be charged with *replanting* those that have disappeared.'

"In America, the Massachusetts State Agricultural Society has lately voted a sum of 10,000 dollars to any proprietor who, in the next five years, shall have planted the largest quantity of land.

"In one of our Australian colonies, steps have recently been taken by the local Government to organize a department for the preservation and extension of forests. A superintendent, with officers under him in different districts, has been appointed at the public expense to attend to this matter. The newspaper which mentioned the resolution so come to, stated that last year, in a particular district named, the fall of rain had been only 17 inches; whereas, twenty years ago, the mean annual rainfall of the district was 37 inches.

"In Scotland, it having been considered desirable to encourage extensive planting, for the sake of shelter, and also of providing useful timber, the Highland and Agricultural Society bestowed prizes, which commenced so far back as the year 1810, and still continue. These prizes have been of different kinds—sometimes several gold medals, yearly distributed, containing suitable inscriptions, sometimes pieces of plate, each of the value of ten guineas. These prizes are awarded to proprietors who have planted the largest quantity of trees of suitable kinds. The result has been to lead to the extension of forests, especially in the Highlands.

"What can the local Government of Malta do towards carrying out these views?

"Looking at what has been done by other governments, the measures adopted by them may be fitly classed under two heads,—repressive and encouraging.

"1. In most countries one of the laws is to punish criminally any one who goes into a forest, belonging whether to government or to individual proprietors, and cuts down or injures a tree.

"In France and Italy, individuals are not at liberty to cut down trees,—at least any considerable number,—without first communicating with the district forest officer, who sees that the trees proposed to be cut are of mature age.

"2. As to the second class, it will be observed that France has for each of the last ten years voted out of the National Exchequer 1,000,000 of francs to aid proprietors in planting. Rewards of a pecuniary nature, in the form of prizes, are given even by private societies in America and Scotland.

"It was stated to the author of these remarks, whilst lately in Malta, by a well-informed gentleman, a native of the island, that one of the Grand Masters of the Order of St. John, to whom the island formerly belonged, being desirous to multiply the number of trees, proclaimed that he would give a piece of money (the value of which was equal to three farthings English) for every carouba tree planted after the date of his proclamation; and that the appeal was so generally responded to, that most of the carouba trees now on the island originated in that way.

"Perhaps in these days, it would be better to adopt measures of encouragement than measures of repression.

"At the same time, it is right that woods should be protected from trespassers, and a penalty imposed on persons cutting or injuring trees belonging to others. Even in regard to the liberty of proprietors to cut trees on their own estates, it should not be without notice first to the district inspector, that he might judge of the reasonableness of the act.

"With regard to the nature of the encouragement which might be given by the local Government of Malta, there is perhaps less difficulty than in most other countries. A very large proportion of the island belongs to Government, especially the hilly parts, which have been retained probably in view of their military importance. Now the highest parts of the island are the most important for forests as rain-producers, and are, at the same time, almost worthless for crops, there being little or no soil on the high grounds.

"Therefore, if the Government resolve to have these hills planted, there can be no obstacle. They have only to appoint a forest superintendent, with a certain sum at his disposal, to import trees or raise them by seed, and then form a strong fence, to protect from trespasses by stock. All the principal highways of the island are maintained by the Government; so that, if trees were planted along these roads, they could be looked after by the road surveyors. If planted on the field side, a law would require to be passed, prohibiting the proprietor and his tenants from injuring them. The different district magistrates, who keep up the district roads, might be bound to plant and maintain trees along them. Such a law prevails both in Germany and France.

"A separate sum should be voted to any proprietor who shall have planted the greatest number of acres in a given number of years—the trees, of course, being in a thriving condition at the time of the inspection, and of suitable kinds.

"There need be no difficulty in finding various kinds of trees suitable for forming plantations. They should be evergreens, so that there shall always be leaves on them. The carouba tree, the loquat, cypresses, pines of various kinds, date-palms, thuyas, laurels, rhododendrons, aucubas, and oaks,—all thrive now in the island, and some of them thrive better in rocky soil than anywhere else. But there are various other plants and trees, not deciduous, and with broad leaves, which could be easily suggested by any botanist whom the colonial Government may be pleased to consult.

"Much has been done for the improvement of Malta in past times. Some of the Grand Masters, under the old *régime*, left many substantial proofs of their wisdom and energy. Since the island came under British rule, several governors have commenced or completed works, for which their memory also is greatly revered. But the measures recommended in the foregoing remarks, would exceed all former undertakings in importance and usefulness,—by the effect they would have in ameliorating the climate, increasing the productiveness, promoting the healthiness, and adding to the beauty of the island."

(To be continued.)

THE BEET ROOT SUGAR INDUSTRY IN THE UNITED STATES.

Concluded from page 371.

The extracts which were given in a previous number from Professor Gœssman's lecture, chiefly related to the growth of the Beets and the analyses of the juice. In the third and concluding part of his lecture the Professor details the method by which he extracted sugar from the juice, with the per centage he was able to obtain.

From this part of his lecture the following extracts are taken :—

"In the course adopted, I adhered, as much as possible, to the modes and the means which intelligent beet sugar manufacturers apply, and modified my plan merely to suit the peculiar circumstances under which I was obliged to work.

"I took fifty pounds of Electoral beet juice (October 18th,) in a suitable copper kettle and heated it quickly but carefully to 80° C., to produce the coagulation of the albuminous substances. I then removed the vessel from the source of heat, and stirred into the liquid one-half of one per cent. of caustic lime, which had been changed into milk of lime. The heat was then applied again and the liquid rapidly raised to its boiling point, and as soon as the steam produced at the bottom of the vessel began to force its way through the compact mass of scum covering the surface, the heat was discontinued and the clear liquid was separated from the scum, after ten to fifteen minutes standing, by means of a syphon. The scum itself was subsequently placed upon a filter consisting of cloth, and the filtrate passed through a thin layer of coarse boneblack to render the juice clear. The previous treatment of the juice of the sugar beet, which is called the process of defecation, aims at the following alteration of its constituents. The heating of the juice to 80° C. causes the coagulation of the albuminous substances and protects them somewhat against the disintegrating reaction of the caustic lime, and particularly of the caustic potassa and soda, which result from the action of the caustic lime upon the organic and inorganic compounds of these alkalies in the beet juice. The excess of caustic lime renders, at a higher temperature, the oxalic acid, the citric acid, and the phosphoric acid largely insoluble, and thus causes their partial removal in common with gum, fat, pectose, and extractive substances in the form of a precipitate. The asparagin is changed into asparaginic acid and ammonia, which continually escapes, with that amount of the latter which results from the constant decomposition of a portion of nitrogenous substance which remained in solution. The organic base, betain, is liberated from its combination with one of the organic acids, and, being very soluble, accompanies the larger proportion of the compounds of the asparaginic acid and the alkalies through the various operations connected with the crystallization of the sugar into the molasses. The sugar forms a definite soluble combination with lime, and by its presence keeps also a large amount of otherwise insoluble lime compounds in solution.* There are various rules regarding the amount of caustic lime required to accomplish the desired result of an economical separation of the sugar from its accompanying substances, but they all aim at an excess of caustic lime in the process of defecation. The excess favours the formation of insoluble basic lime compounds, the subsequent disintegration of soluble albuminous substances, and particularly it shortens the entire process of defecation, a result most desirable for the production of a copious precipitation, which would be more or less interfered with in case the liberated alkalies were permitted to continue their disintegrating influence upon the scum for any length of time. A successful defecation, considering everything else equally favourable, aids in an unusual degree the entire subsequent process. To remove the foreign substances from the beet juice rather by precipitation than by disintegration, ought to be the aim of the beet sugar manufacturer, yet those who claim superior results, (Jelinske,) remove it seems but fifty per cent. of soluble non-saccharine constituents of the juice. No other process connected with the beet sugar manufacture has been more frequently discussed than that of defecating the juice, and there prevails a greater diversity of opinion among mannfacturers on that point, with the exception probably of the most efficient and at the same time the most economical means of securing the juice from the roots, than on any other point connected with the business.

"The defecated juice, obtained as above described, was of a light yellow colour, transparent, and of a strong alkaline reaction. To secure the full effect of the lime in solution, I concentrated the juice in an open copper vessel by means of a steam bath to 30° Brix, and treated it at 50° C., with carefully washed carbonic acid gas until the precipitate of carbonate of lime settled readily to the bottom.† The clear solution was heated to 95° to 100° C., and subsequently passed through a bone-black filter, which was kept by means of steam at 95° C. I used one pound of bone-black for every pound of sugar in the juice. The solution thus obtained was carefully evaporated to crystallization, and the sugar collected at three different

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"*A well defecated juice contains about twice as much caustic lime in solution, as lime water does.

"† From 0·08 to 0·09 per cent. of caustic lime is frequently left in solution to be removed by bone-black afterwards. From 10 to 20 lbs. of bone-black are used for every 100 lbs. of beet roots.

times. It amounted to somewhat more than eight per cent. with separation still going on slowly. The operation was several times repeated with the juice of the Electoral, and of the best Imperial beet, and the sugar resulting was firm in grain and of good colour. Experiments on a smaller scale yielded from a juice which contained 13·19 per cent. of sugar, 9·4 per cent. in a crystallized form, which has been valued by experienced sugar refiners at from 8·5 to 9 cents per pound for refining purposes. Being obliged to work without a vacuum pan, &c., and obtaining as stated eight per cent. of a good sugar, worth at least eight cents per pound, I feel quite entitled to say that the sugar beets raised upon the college farm, particularly the vilmorin and the electoral, though not of the highest order, are well qualified for the economical manufacture of beet sugar. With proper care in selecting good seeds and a fit soil, it is quite apparent that the sugar beet promises with us as good results as in Europe. Our long and moderately warm fall season may even give us a decided advantage over many localities in Europe, a question which good native sugar beets are most likely soon to decide.

"Our method of planting the sugar beet did not promise more than 18,000 plants per acre, which according to our actual test produced roots equal to about one and one-fourth pounds each. In case the implements on hand would have allowed to carry out the proposed arrangement, (the rows but twenty inches apart and the individual plants eight inches from each other in the rows,) from 28,000 to 28,500 plants might have been raised, which at the same average weight of the roots would amount to 32,000 or 34,000 pounds per acre. At this rate of production, it is quite safe to say that from 1900 to 2000 pounds of sugar would be its produce per acre. These figures, which are as will be conceded well supported by actual tests here and elsewhere, oblige me to alter the valuation of the produce per acre from that of my first report. For obvious reasons, I adopt here again rather the lowest rates than the higher ones, although the field on which the experiments were made, was by no means equal in fertility to the alluvial soil of the Connecticut.

	Dols.
Sugar, 1900 pounds, at eight cents per pound	152·00
Molasses for feeding purposes	3·66
Press-cakes, $17·40, crowns, $4·00	21·40
Leaves, as manure or fodder	12·00
	Dols. 189·06

"To this amount should be added the profit on fodder converted into milk, beef, and manure.

"Making allowance for exceptionally good results, which are in Germany, for instance, 2270 pounds of sugar per acre, 29·60 dols. would have to be added to the above sum. Adding one cent to the value of each pound of sugar, which considering our present market prices seems to be warranted, would be 15·20 dols. more, making the entire yield 222·86 dols. per acre. There are also incidental profits arising in the manufacture of sugar, which benefit particularly the agricultural interest, which were not enumerated in my former report. Two sources of additional profit deserve particular attention here. The process of defecation requires the application to the juice of from one to several per cent. of caustic lime. The scum resulting from this operation contains a large percentage of phosphoric acid, magnesia, nitrogenous, and non-nitrogenous organic constituents of the beet juice, a considerable quantity of caustic and carbonate of lime, and these are in such a state that they may serve, after some composting, as an efficient fertilizer. In its original condition, it consists of about 60 per cent. of water, 22 per cent. of organic substances, and 18 per cent. of inorganic substances, and has been counted in this state equal to its own weight of stable manure. This mass is frequently pressed to save sugar, and varies of course somewhat in its composition. One acre of beet roots causes the production of about 750 pounds of pressed scum of the following composition:—

	Pounds.
Caustic and carbonate of lime	254·80
Potassa and soda	3·00
Magnesia..............................	14·20
Phosphoric acid.......................	14·20
Sulphuric acid	·30
Nitrogen..............................	11·80
Organic substances	300·00
Water	151·70
	750·00

"The refuse matter (spodium,) resulting from the clarification and decolorization of the sugar solution, is also worth mentioning in this connection, as an important source of an excellent material for the manufacture of superphosphate. The peculiar benefits which the agricultural interests of a country derive, directly or indirectly, from the introduction of the beet sugar industry, under judicious management, have never been seriously questioned. I express but the prevailing opinion of European agriculturists, when I again assert, that wherever the promotion of rational principles in agricultural pursuits is a desirable object, or where a declining productiveness of the soil calls for efficient assistance, there it will be found of inestimable service to study the ways and means by which the true relation of the various farm crops to the sugar beet have been ascertained, and the beet sugar manufacture rendered a lucrative agricultural and industrial business."

In concluding his report, Professor Gœssman considers with care and impartiality the probability of the beet sugar manufacture proving profitable in the United States, and draws favourable conclusions from the difficulties which have been overcome on the Continent of Europe, from the higher prices of sugar obtained in the States, and from other considerations. He seems scarcely to estimate sufficiently the difficulty of procuring labour, for though beet sugar machinery has been brought to a high state of perfection, the beet culture necessitates the employment of a considerable amount of hand labour, of a sort, we should think, not easy to procure in quantity in the United States.

ON A STEAM JET FOR EXHAUSTING AIR, &c.

From a Paper by

C. W. Siemens, Esq., D.C.L.,

In the Proceedings of the Institution of Mechanical Engineers.

The steam jet, although it has been used with such remarkable success for producing a current of air to form an artificial draught in locomotive and portable engine boilers, has hitherto been extremely limited in its application to other purposes; for though its simplicity for the propulsion of air is a great recommendation, the effect realized from a given expenditure of steam has been extremely unsatisfactory, in comparison with the results of the same steam in working an engine and air-pump.

In an improved steam jet a very thin annular jet of steam is employed, in the form of a hollow cylindrical column, discharged from an annular orifice between two conical nozzles, the steam being supplied from a pipe between the two nozzles. The inner nozzle can be adjusted up or down by a hand screw, so as to diminish or increase the area of the annular orifice between the two nozzles for regulating the quantity of steam issuing. The air to be propelled by the steam jet is admitted from another pipe through an exterior annular orifice surrounding the steam jet, and also through the centre of the hollow jet. The tube into which the steam jet issues is made of conical shape at the bottom, so as to form with the outer nozzle a rapidly converging annular passage for the entrance of the air, and the width of this air passage is regulated by adjusting the outer nozzle by means of a nut at the bottom. The tube continues to converge very gradually for some distance above the jet orifice, the length of the convergent portion increasing with the width of the outer annular air orifice, and also with the steam pressure employed; the most advantageous length varies from twelve to twenty times the width of the annular air orifice, the object being to ensure the complete commingling of the steam and air within the length of the mixing chamber, beyond which the tube gradually increases in diameter in a parabolic curve to the upper end. A tapering spindle is sometimes fixed in the centre of the inner nozzle, and carried up through the mixing chamber, for the purpose of preventing reflux through the centre of the combined current.

The results of a long series of experiments with this form of steam jet, both for exhausting and compressing air, have led to the following conclusions:—

First, that the quantity of air delivered per minute by a steam jet depends upon the extent of surface contact between the air and the steam, irrespective of the steam pressure, up to the limit of exhaustion or compression that the jet is capable of producing.

Second, that the maximum degree of vacuum, or of pressure attainable, increases in direct proportion to the steam pressure employed, other circumstances being similar.

Third, that the quantity of air delivered per minute within the limits of effective action of the apparatus, is in inverse relation to the weight of air acted upon, and that a better result is therefore realized in exhausting air than in compressing it.

Fourth, that the limits of air pressure attainable with a given pressure of steam are the same in compressing and in exhausting, within the limits of a perfect vacuum in the latter case.

The following Table gives the results obtained with the steam jet arranged as an exhauster for drawing air out of a closed vessel having a capacity of 225 cubic feet. The last four columns show the vacuum produced in the vessel, measured in inches of mercury, when the exhauster had continued in action for the length of time indicated in the first column. The pressure of steam in the boiler was 45 lbs. per square inch, and the sectional area of the annular steam orifice of the jet was varied from 0·05 to 0·20 square inch.

Experiments with steam-jet exhauster, exhausting air from a closed vessel.

Time of Action.	Area or Annular Orifice of Steam Jet.			
	0·05 sq. in.	0·10 sq. in.	0·15 sq. in.	0·20 sq. in.
Minutes.	Vacuum. Inches of Mercury.	Vacuum. Inches of Mercury.	Vacuum. Inches of Mercury.	Vacuum. Inches of Mercury.
1	9	10	9¼	8½
2	13	13½	13½	13
3	14½	15	16¼	15¾
4	15½	15½	17¼	17
5	15¾	15⅞	18	17¾
6	—	—	18½	18¼
7	—	—	18¾	18½

The system has been applied to pneumatic despatch tubes, in which the steam jet has a great advantage in simplicity and first cost, and in the small amount of space required. One of the principal lines in London was worked experimentally by means of three steam-jet exhausters, so arranged that all three drew air out of the same tube, the steam being supplied to them by the same steam pipe. When working with these three exhausters, the mean speed of a piston carrier travelling through the tube from Charing Cross to Telegraph Street was 14⅓ miles per hour. The vacuum maintained in the tube was equivalent to 10 inches of mercury, the steam pressure being 40 lbs. per square inch, and the quantity of coal consumed under the boiler was 56 lbs. per hour.

Evaporation of Sugar.—Another application of the improved steam jet is to the evaporation of sugar. In consequence of the remarkable results obtained with this steam-jet exhauster, it is proposed by Mr. R. A. Robertson, of London, to apply it to sugar boiling in the West Indies, and he has communicated to the writer the following notes on the subject:—

"The steam-jet exhauster has been employed experimentally with considerable success in exhausting vessels for evaporating liquids in vacuo, and its application for this purpose promises to become of great value in the colonies for evaporating cane juice, principally on account of the simplicity of the arrangement. The great loss and deterioration consequent on the high temperature to which cane juice must be exposed for evaporating it on the old system in open pans are well known, and many ingenious pans have been invented, and to some extent worked, for evaporating at low temperatures; but on account of the improved pans being either very much more costly, or requiring much more skilled attention to work them, the greater part of the sugar produced is still made on the old and wasteful plan. Of all the contrivances for evaporating at low temperatures, the ordinary vacuum pan, exhausted by pumps, is at present the best when carefully designed, and in it, under favourable circumstances, very rapid evaporation can be produced at low temperatures. In the sugar-growing colonies, however, almost every circumstance is unfavourable for this mode of working: the water required for condensing the vapour from the evaporating pan is warm, and consequently must be used in large quantities, thereby necessitating large pumps for its removal, and for exhausting the pan; the pumps and motive power thus form together, with the pan, a very costly apparatus, which requires a considerable amount of skilled attention, often not obtainable, and frequent repairs.

"On the contrary, a vacuum pan exhausted by the steam-jet exhauster is a very simple apparatus, only requiring a supply of steam at a moderate pressure for the jet which exhausts the vapour given off by the boiling solution of sugar or other liquid in the pan, and the steam and vapour together are then passed through the heating tubes of the pan, thereby producing evaporation. The area of the steam-jet is regulated by a hand wheel. By this arrangement the costly vacuum pumps and the steam engine, or other motive power, are dispensed with, as well as the condenser and its supply of condensing water, the latter being in many places a consideration of vital importance, and in their stead is substituted the steam-jet exhauster—a comparatively cheap and simple apparatus requiring little or no attention, and not liable to get out of order.

"Experiments on this mode of evaporating have been so successful that a vacuum pan is now being constructed as above described, capable of evaporating 50 cubic feet of water per hour, in which it is estimated that a vacuum of from 18 to 20 inches of mercury will be maintained. The usual form of vacuum pan is the simplest arrangement to which the steam-jet exhauster can be applied for the purpose, but the exhauster can with equal advantage be applied in those cases where vacuum pans are worked on the systems known as the double and triple effect. It has been successfully employed to exhaust a vacuum pan having a condenser placed high enough above the ground to discharge, by gravitation against the vacuum, the condensing water in which the vapour from the pan was condensed; there was thus left only the air and a very small quantity of vapour to be removed by the exhauster, which in this case was a very small one, not using sufficient steam to produce evaporation.

"The steam-jet exhauster is further expected, on account of its cheapness and simplicity, to prove very useful in the colonies for draining the molasses from the sugar by exhausting the air from below the perforated bottom of a strainer containing the undrained sugar, the pressure of the atmosphere then driving the syrup or molasses through the sugar and perforated bottom. By this means the crude and imperfect mode of draining by gravitation, and also the more elaborate, but costly and troublesome centrifugal strainers can be superseded with advantage."

Mechanical engineers have long received with respect any suggestions that have proceeded from the fertile brain of Dr. Siemens; whatever subject he has touched he has treated with the ability of a master, and in no researches has he been more successful than in those which have led to the improvement—we might almost say to the perfection—of the steam jet. He has, in fact, applied the principle of the Giffard's injector to the propulsion of air; but though the general construction of the steam jet and the injector are analagous, their mode of action differs. Very much must yet be done, moreover, before the steam jet can be of much use for maintaining a vacuum in apparatus for the concentration of sugar. It is one thing to produce a vacuum in a closed vessel, and under favourable conditions, and a more difficult one to maintain it in a vacuum pan within which violent ebullition is carried on; but our readers will know that even the maximum of vacuum hitherto obtained would be practically useless for a vacuum pan. The scheme of withdrawing the vapour from a vacuum pan, together with the air, by means of a jet is not a promising one. The total number of cubic feet of vapour that would so need to be removed would be far in excess of the powers of the jet. If, however, the water were to be removed by a barometric tube, the jet might be dispensed with altogether; for we have seen a vacuum maintained by an ingenious contrivance, whereby the air was carried down with the water, and this vacuum was much more perfect than the best that has hitherto been maintained by the jet. Yet, as it was unequal to that maintained by air pumps, the boiling point of the sugar was not sufficiently reduced, and the plan had to be discarded.

BURNING OF A BOSTON SUGAR REFINERY.

A destructive fire occurred on Thursday evening, 8 Aug/ in the large six-storey building known as the Continental Sugar House and Refinery on A street, South Boston. The damage is estimated at 500,000 dols. The entire building was destroyed, together with the machinery. One hundred and fifty men are thrown out of employment. There was a large amount of stock in the building, which will be a total loss. The loss is supposed to be partly covered by insurance in Boston, New York, and other offices.

ON THE MANUFACTURE OF SUGAR FROM THE SUGAR-CANE; AND THE MACHINERY EMPLOYED THEREIN.

Continued from Page 62.

Part X.

In our last paper upon this subject we treated of the various arrangements of open air low temperature pans, and of the manner of their employment.

Next in order comes the system of manufacture in general use in Demerara, in which the clarified juice is as before, concentrated in the Jamaica train up to a density of about 24° to 27° Baumé, and the concentration is then finished in the vacuum pan.

This apparatus, originally invented by the Hon. Edward Charles Howard, in 1813, has been of enormous practical value to the sugar manufacturer. In it, advantage is taken of the fact, that fluids will boil at a much lower temperature when the pressure of the atmosphere is wholly or partially removed from them, than when they are exposed to the ordinary atmospheric pressure.

Thus, while a temperature of over 230° Fahrenheit is reached in boiling to a grain in the tayche, the vacuum pan will boil to a small grain, where the main object is to produce a good colour, at a temperature not exceeding 140°, and it will boil to a "clear proof" at as low a temperature as 130°. When, however, it is desired to form a largo, firm grain, these temperatures must be considerably exceeded.

It will be at once seen that the power to boil rapidly at such low temperatures enables the planter to conduct his concentration with but slight injury to the juice, and makes it practicable for him to keep the concentrating syrup under operation for a sufficient length of time to get large crystals, without too great injury either to the colour or composition of the product.

The vacuum pan consists essentially of a pan in which the evaporation is effected, and of a condenser, whilst an air-pump is always employed in connection with it. This pump is made use of to produce the vacuum in the first instance, by exhausting the air, and to maintain it afterwards by removing any air which may enter with the condensing water, or by means of imperfect joints. The lower half of the evaporating pan is usually steam-jacketed, while the interior contains one or more coils of copper steam-piping; it will thus be seen that the evaporation is here effected entirely by steam heat. From the upper portion of this pan a large pipe leads to the condenser, which is (we believe we may say almost invariably), an injection condenser. Here the vapour arising from the boiling liquid is condensed, whilst any air which may enter either through imperfect joints or in the condensing water is removed by the air-pump. This pump is also generally used in the colonies for removing the condensing and condensed water. In the home refineries, however, the vacuum pans are usually placed at such a height that the water can flow away from them without being pumped, so that the pump is in these instances used only for removing the air. In this case, however, the bottom of the condenser must be at least thirty-two feet above the level at which water can freely flow away, and the pipe leading from it must dip into a vessel of water so that it can never become uncovered. Then, since there is the pressure of the atmosphere acting upon the water outside the pipe, and a more or less perfect vacuum within it, the pipe will be filled with water until the weight of the column of water inside balances the pressure of the air on the water outside. Then the addition of any further quantity of water coming from the condenser will make the pressure of the column of water inside the pipe greater than that of the atmosphere outside, and the water will immediately begin to flow away. The attempt has been made to utilise the downward flow in a pipe thus arranged, and the shower of water in the condenser, to entangle any air which may be present and carry it away without the help of an air-pump. It has not, however, proved practicable to obtain by this means a vacuum sufficiently good to make the arrangement a desirable one for the sugar manufacturer.

Vacuum pans are most generally made of copper, though the steam jacket before alluded to is of cast-iron. In some cases, however, the whole of the pan is of cast-iron; but pans thus constructed have no steam-jacket, and are heated only by the copper worms within them.

The shape of the pans varies much. Some are of large diameter, and comparatively shallow; these are used chiefly when it is desired only to boil to "clear proof" or to small-grain. Others are almost spherical, being only slightly flattened at top and bottom, while others again are even greater in depth than in diameter.

When it is wished to form large crystals in the vacuum pan, the first charge is boiled down to such a consistency that crystals are formed in it, and then little by little fresh syrup is added, the evaporation being continued meanwhile; thus, fresh saccharine matter is furnished and time is allowed, so that the crystals may grow larger and larger. This goes on until the pan is full; even then only a portion of the charge is withdrawn, and the same operation is again continued. Thus where the aim is to produce the largest possible crystals, the pan is never entirely emptied from the time it is started in the morning until it stops for the night. It is also essential to the formation of large, firm crystals to keep the temperature fairly high, say at 170° to 180° Fahrenheit.

A vacuum pan is usually furnished with many adjuncts: a measure, by means of which the quantity of liquor admitted to it may be known; sight glasses, through which a glimpse of the contents may be obtained, thus affording a means of judging of their condition; a cup, by means of which butter or sweet oil may be introduced, should the boiling liquid foam and froth so much as to run the risk of boiling over; a "proof-stick," which affords a means of removing a portion of the syrup from the pan for examination, without destroying the vacuum; a "tell-tale" to catch any liquor which may be carried over with the vapour towards the condenser, and which, if not thus caught, would be lost; besides man-hole, gauge-glasses, discharge valve, vacuum gauge, &c., &c.

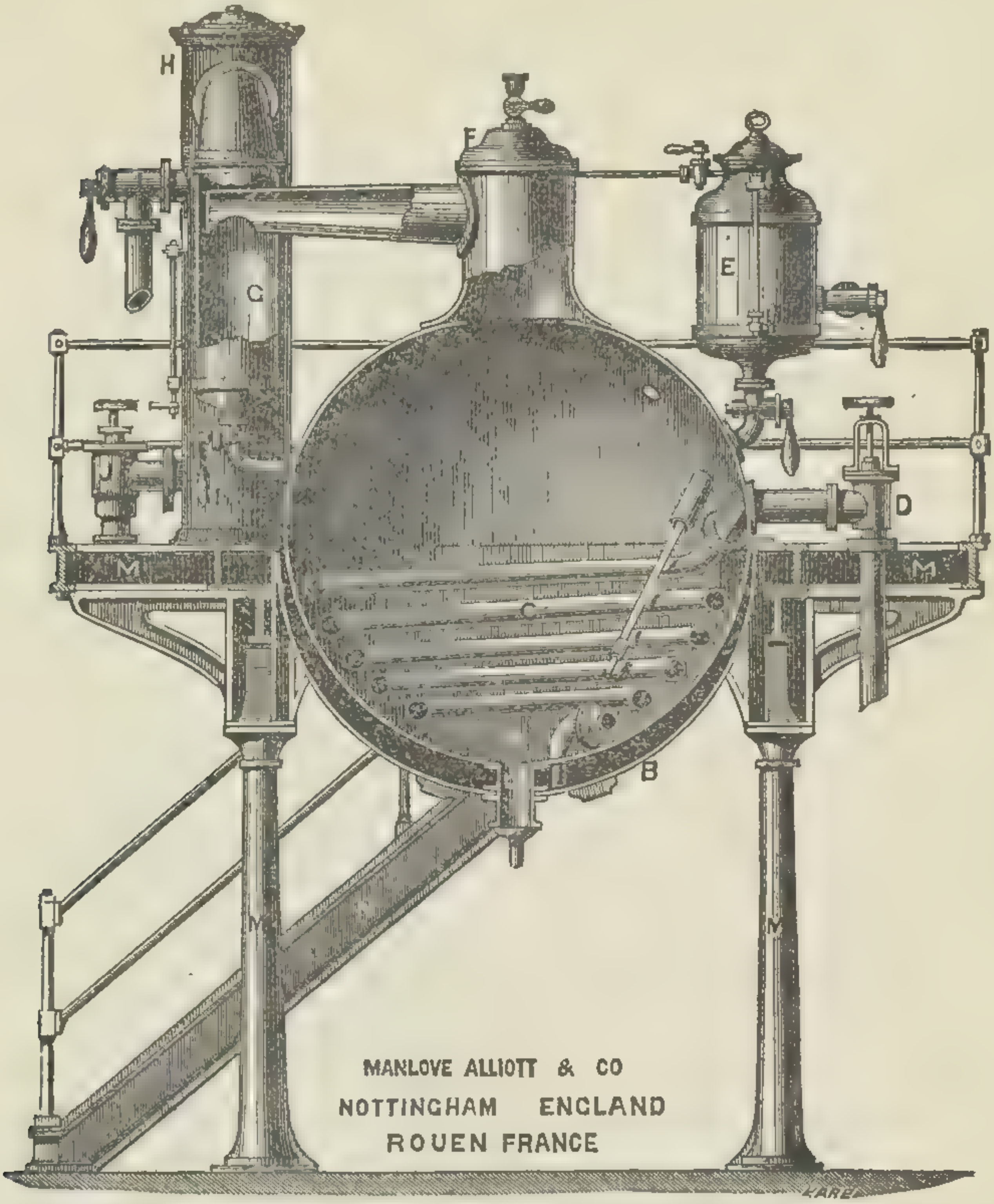
A good deal of skill and experience is necessary for the efficient working of a vacuum pan. An unpractised hand would find great difficulty in producing even and regular crystals with it, and would run the risk of either discharging the sugar before it was sufficiently concentrated, or else of letting it set in the pan, a thing which, when it happens, causes considerable trouble. On this account, and because the machinery requires constant attention and care, the vacuum pan is rarely used except where there is efficient European superintendence.

It is also usual where this system of concentration is adopted to take special care to render the juice to be operated upon pure and bright. Thus, in Demerara the clarification as the juice flows from the mill is not thought to be sufficient, but is supplemented by subsidence after the syrup leaves the Jamaica train, and before it goes to the vacuum pan. This "subsidence" consists in allowing the syrup to remain for some time, usually about a day, in vessels called subsiders. This permits all the heavy impurities to settle to the bottom, and the clear liquor above is drawn away to the vacuum pan.

In other parts of the world filtering the juice, either through bag filters, or through animal charcoal, or through filter presses, (all which apparatus we shall have occasion to describe hereafter) is substituted for the subsidence practised in Demerara.

Filtering through animal charcoal not only removes solid impurities but also causes absorption of the colouring matter. It is rarely, however, possible in the sugar-producing countries to use sufficient charcoal entirely to remove colour, and leave a bright white sugar behind; and the too frequent result of the use of charcoal is consequently the production of a dull-grey white unattractive-looking sugar, instead of a blooming yellow one.

The sugar may either be taken direct from the vacuum pan to the centrifugals to be drained, or it may be placed first in coolers, and only be sent to the centrifugals after it has stood some time in them to cool and crystallize. In this latter case it usually requires to be passed through a crushing mill and broken up before it can go to the centrifugal. The treatment at this point varies according to the quality of the syrup undergoing manufacture, and the class of sugar being produced.



In the sketch of a vacuum pan, which we append to this paper, AA represent the copper pan; B is the cast-iron jacket surrounding the lower portion of it; C, the copper heating coil; D, the valve supplying steam to the coil and jacket; E, the measure provided with suitable cocks, gauge-glasses, &c.; F, the man-hole, fitted with air-cock; G, the tell-tale, through which the vapour passes on its way from the pan to the condenser, which is marked H; I is the cock supplying condensing water; J, the valve leading to air-pump; K is the proof-stick; L, the discharge valve; MM represent the framing upon which the whole is supported; and N is the staircase leading up to it.—*British Trade Journal.*

(To be continued.)

IMPROVEMENT OF THE POLARISCOPE.

M. Duboscq has lately brought out what is called a new saccharometer, the difference between which and the ordinary instrument is chiefly that the disc, which in the latter is coloured, in the new instrument presents when at the point of polarization two shadows of equal size and density. The idea on which the latter is based, originated with Mr. Jellett of Dublin. The principle is explained in two letters—one by M. Maumené; the other by M. Champion, which lately appeared in the *Journal des Fabricants de Sucre*—the substance of both of which is given below.

From M. Maumene's Letter.

"The Polariscope has been very greatly improved. M. Duboscq, the well-known optician, is bringing M. Soleil's beautiful instrument to a state of great simplicity and precision. He has utilised for this purpose a very ingenious idea of M. Jellett, of Dublin, with which he became acquainted through M. Cornu, one of our most scientific and advanced physicists.

"The following is M. Jellett's idea. Polarized Light, by its passage through a Nichol's prism, acquires the characteristic property of being extinguished when attempt is made to pass it through a second Nichol's prism, of which the principal axis is at right angles with that of the first. If the second prism is placed in the same position as the first, their principal axes parallel, the light which passes through the first passes through the second as though there was no obstacle, and the eye sees clearly through them both; but if the second prism is slowly turned the light becomes gradually feebler, and when the principal axis of the second prism crosses that of the first, the light is totally cut off.

"This fact has been long known, but to M. Jellett has occurred the ingenious idea of using it for providing a substitute for Soleil's admirable invention of the double rotation plate, which forms a necessary part of his polariscope, now become indispensable to all who are engaged in the study or manufacture of sugar. Imagine then a Nichol's prism with its principal axis placed vertically:—beginning at the under face, cut through, both right and left of the axis, sections making at their apex angles of 2½° each with the perpendicular. The prism will thus have lost from its centre a prismatic wedge of 5°, divided into two equal parts by the principal axis of the original prism. Now bring together the two chief parts of the prism, and consider the effect which will be produced by it in this irregular shape. Its principal axis is no longer horizontal, it forms a broken line of which the two parts are each 87½° from the vertical. Now place the eye behind the second Nichol's prism (preserved intact) and you will be in a position to observe the very curious effect on which the new saccharometrical process is based.

"When the second prism, the analyzer, receives the light which has passed through the first, the double polarizer (as I call it), it will be understood that the extinction of light by the crossing of the principal axes will not now take place at the same time on the two halves of the polarizer; when the analyzer is at right angles with the left half of the first prism, it will be 5° from being so with the right half. The extinction of light will be complete, or very near it, on the left half, whilst the right half will remain visibly illuminated. We have but a word or two to add. If the analyzer is turned 2½° from the position where it is at right angles with the left half, that is at 92½° from the principal axis of the left half, a little light will pass through it. At the same time the already feeble light on the right half will be diminished; and thus the degree of obscurity on the two halves may be brought into absolute equality, because both will make an angle of 87½° with the principal axis of the analyzer. It is in this way that M. Jellett has aimed at introducing a more precise and simple means of saccharometrical observation.

"Thanks to M. Duboscq, this aim is perfectly accomplished; in fact, a saccharine solution may be examined between the two Nichol's prisms, the same as between Soleil's double rotation plate and quartz compensator, another not less admirable part of his polariscope.

"The saccharine solution deflects the plane of polarization at a certain angle, and this angle is the same for the two halves of the double polarizer, and the light which has first passed through this polarizer, then through the tube of saccharine liquid is presented to the analyser in the ordinary conditions. The deviation produced by the sugar may then be noted not by observing the equality of the two lights, but observing the equality of the two obscurities. M. Jellett has retained the valuable principle of Soleil, but has discovered a surer method of applying it, by avoiding the fatigue to which the eye is so subject by the comparison of two colours more or less bright. The sensation caused by the use of the new saccharometer is not in the least fatiguing, as is the case in the prolonged practice of the ordinary polariscope. The gradual extinction of the light causes a pleasant sensation; the comparison of the two shadows becomes less and less difficult, and the nearer the end of the day's labours the more delicately can the powers of the eye be exercised.

"The numerous experiments which I have made with the instrument I have received from M. Duboscq, have more and more convinced me of the value of the new method. Persons, the most unaccustomed to optical observation, have seen at the first glance the equality of the two shadows, and they have invariably agreed with my own observation. The precision of the new method is greater for many reasons.

1. Because the comparison of two shadows is easier than that of two bright colours. In certain cases other colours than the sensitive tint are required, and the compensation is in such cases not rigorously proportional to the quantity of sugar.

2. The measurement in the new saccharometer is essentially angular. The reading of the scale may thus be made of unlimited range.

3. It is easy to employ highly concentrated liquors and consequently to reduce the proportion of any observational errors.

"M. Duboscq's apparatus realizes so great a saccharometrical progress that I have not been able to resist the desire of making it known. M. Duboscq has rendered the task as agreeable as possible. Although the new saccharometer may be an almost incredible step in advance, our excellent optician does not wish to put *fabricants* and chemists to any unnecessary expenses, he sees the necessity of reducing the new *materiel* to a minimum. All that is in use in the present instrument may be employed in the new one, except the optical parts. The same tubes, the solution phials, all except the supports of the double rotation plates and of the compensator, may be used in the new saccharometer.

"The new instrument needs some special explanation and I have undertaken to make known as soon as possible the bases of the method, the details of its use, with explanatory tables and figures.* I shall take care to advertize the publication of the little pamphlet which M. Duboscq wishes to accompany each of the instruments which he sends out."—*E. Maumené.*

From M. Champion's Letter.

"The sensibility of this new saccharometer is nearly four times greater than that of Soleil, and its use can be learnt much more rapidly.

"The idea of measuring the angle of polarization by the equality of shadow on two darkened plates originated with Professor Jellett, of Dublin. The chief improvement made in the method by M. Cornu consists in the adaptation to it of the yellow monochromatic sodium light which triples or quadruples the sensibility, not only because of its intense brightness, but especially because of the purity of the luminous radiation. As a second improvement, M. Cornu has studied and determined the most suitable angle to adopt in the cutting of the Nichol's prism. Notwithstanding this, the polarizing apparatus which M. Cornu wished to put at our disposal some months ago, required too delicate handling; this we have remedied by adding an adjusting screw which, on the equality of the shadows approaching, permits of the exact determination of the corresponding division on the index.

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* The light employed for the new saccharometer is monochromatic, *i.e.*, simple. Up to the present time all concur in preferring the yellow light produced by chloride of sodium placed in the flame of a Bunsen burner. I have studied the influence of other lights which will with your permission explain in another article. This is an essential point.

"The great sensibility of the instrument allows of the use of twice the number of divisions on the scale, that are on that of the ordinary polariscope. This is the only part which we claim in the improvement of this saccharometer, which we doubt not will render important service to the sugar industry.

"Whilst the ordinary instrument does not permit of reading nearer than half a degree, corresponding to a half per cent. of sugar, M. Cornu's saccharometer, with the above addition, permits of reading within a quarter of a degree, say 0·25 °/o of sugar. To show more clearly how this will work, we add below part of a table constructed by the aid of M. Cornu's saccharometer, in which the left-hand column contains the figures of the ordinary polariscope, and the middle the reading of the new apparatus.

"In conclusion we may remark that the use of the monochromatic light produced by sodium or thalium does not absolutely necessitate the use of gas, for which an ordinary soldering lamp may be substituted.

TABLE OF ANALYSIS OF SACCHARINE SUBSTANCES:—

Ordinary Polariscope.	Cornu's Saccharometer.	Sugar per cent.
91·0	393·12	91·100
—	393·66	91·125
—	394·20	91·250
—	394·74	91·375
91·5	395·28	91·500
—	395·82	91·625
—	396·36	91·750
—	396·90	91·875
92·0	397·44	92·000

"This table has been constructed on the same basis as that of the ordinary polariscope, 16·35 grms. of sugar dissolved in 100 c.c. of water, in order to make the observations comparable."—*P. Champion.*

CHEMICAL MANURES IN THE CULTURE OF THE SUGAR CANE.

The latest edition of M. Georges Ville's valuable work on Chemical Manures contains at the end of the 2nd volume, a report by M. de Jabrun, President of a Commission on the subject, in which account is given of the results of many experiments with different manures in the culture of the cane in Guadeloupe* A translation of some portions of this report with the experiments will no doubt interest many of the readers of this magazine.

After some introductory observations the report proceeds:—

Our experiments were directed to three principal points.

1st.—To ascertain the effects of chemical manures, and whether as regards the cane they are as efficient as farm-yard manure.

2nd.—To fix by experiment the formula of the manure best adapted to the necessities of the cane.

3rd.—To determine the duration of the action of this manure.

The results collected by the Commission are of two orders; those ascertained before its constitution, and since, either by its members or by co-operators.

On the first question whether chemical manures possess the same efficiency as farm-yard manure, the accounts received at Guadeloupe, Martinique, and at Reunion, are concordant. A marked superiority has nearly always been shewn by the chemical manures.

Before the formation of the Commission (in 1866) M. de Jabrun had obtained at Mahault Bay the following results:—

	Weight of Canes to the Hectare.	To the Acre.
Complete Manure	57,600 kilogrms.	about 23 tons.
Farm-yard Manure	32,000 ,, ..	,, 13 ,,
Land without Manure ..	3,000 ,, ..	,, 1·2 ,,

The contrast between these returns is striking. Absolutely, they are very poor; the exceptional dryness of the season of 1866 being sufficient explanation of the cause.

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*Les Engrais Chémiques Entretiens Agricoles, &c., &c., par M. Georges Ville. Paris Librairie Agricole de la Maison Rustique, 26, Rue Jacob.

The experiments of 1867 carried out by the members of the Commission and their co-operators with better prepared manures are still more decisive: three times out of four the chemical manures proved superior to farm manure, as may be seen by the declarations of the experimentors taken in the Law Courts, 19th October, 1867.

M. de Jabrun, Mahault Bay (1867).

	Canes to the Hectare.	To the Acre
Chemical Manure (30 kilos. Nitrogen),	84,872 kilos.	about 34 tons.
Farmyard Manure	63,360 ,,	,, 25 ,,
Soil without Manure	26,575 ,,	10½ ,,

M. Le Compte de Chazelles.

Some ratoons of the third year treated by Manures Nos. 1, 2, 3, and 4, produced 45,980 kilogrs. of cane to the hectare (about 18 tons to the acre).

Some of these ratoons having received a stronger dose than the others of Manure No. 3, were very superior—they were in no way inferior to the finest plant canes.

M. Bentier, Port Louis.

On the 30th June, 1867, 84 ares (about 20 acres) of canes were manured at the rate of 120 grammes of compost per root. A piece of 4 ares adjoining had before been half manured with farm-yard manure, beside 90 grammes of guano per root, or 1,000 kilogrs. per hectare (about 8 cwts. per acre). The 13th October, when last inspected, the plantations were magnificent, but the canes, manured with the chemical compost were the superior.

Some trustworthy accounts from Martinique agree in all points with what has gone before; thus:—

M. Eustache, Galion (Martinique).

	Canes to the Hectare.		To the Acre.
Chemical Compost, No. 1	52,000 kilogrms.		about 21 tons.
Stable Manure	50,900 ,,	..	,, 20 ,,
Peruvian Guano	45,200 ,,	..	,, 18½ ,,
Colza Oil-Cake	43,900 ,,	..	,, 18 ,,
Carbonated Manure	40,000 ,,	..	,, 16 ,,
Soil Unmanured	33,200 ,,	..	,, 13½ ,,

In this experiment the excess of crop produced by the chemical compost over that from unmanured soil was 19,000 kilogrms.; in the average of experiments in Guadeloupe it was 50 to 55,000 kilogrammes.

The experiments in 1868 confirmed those of 1867 at all points.

M. Bentier, Port Louis.

	Per Hectare.	Per Acre.
Canes with Chemical Manure produced in Sugar	5,380 kilogrms.	about 21½ cwt.
Corresponding to a weight of Canes of nearly	74,000 ,,	.. nearly 30 tons.

Another experiment by M. de Laroche, yielded nearly the same results.

M. de Poyen of Saint Anne, obtained with manures Nos. 1, 2, and 4, an average of 63,700 kilogrammes per hectare, although the cane patches were ravaged by rats.

One hectare treated with farm manure (50,000 kilogrammes, about 20 tons to the acre) yielded 55,000 kilogrammes of cane (about 22 tons to the acre).

In presence of this unanimous testimony the Commission does not hesitate to affirm that the chemical manure is very efficient.

The second article of the programme of the Commission was to define by experiment the formula of the compost best adapted to the needs of the cane.

We have ascertained in accordance with M. Ville's previsions, that of the four substances of which the chemical manure is composed—the nitrogen, so valuable in the culture of a great number of plants, only fulfils a secondary function with the cane; further, that the phosphate of lime possesses a decidedly predominant action, which the following experiments prove:—

	Canes to the Hectare.	Per Acre.
Compost No. 1 (without nitrogen)	75,782 kilogrms.	about 31 tons.
,, No. 2 (30 kilogrms. ,,)	84,782 ,,	,, 34 ,,
,, No. 3 (45 ,, ,,)	79,732 ,,	,, 32 ,,
,, No. 4 (60 ,, ,,)	86,840 ,,	,, 34½ ,,
,, No. 5 (90 ,, ,,)	87.267 ,,	,, 35 ,,
Acid Phosphate of Lime alone	68,875 ,,	,, 27½ ,,
Soil without any manure......	26,575 ,,	,, 10½ ,,

We see that the acid phosphate of lime alone was sufficient to increase the yield of canes from 10½ tons to the acre obtained on unmanured land to 27½ tons—an increase of 17 tons to the acre; whilst the addition of potash and nitrogen to the phosphate of lime produced an increase of more than 6 tons to the acre over the yield obtained from phosphate of lime used alone.

Thus, the action of phosphate of lime is shewn to be preponderant, and therefore manure should be composed with this fact in view. The following is the formula which has given the best results:—

	To the Hectare.	To the Acre.
Acid Phosphate of Lime....	600 kilogrms.	535 lbs.
Nitrate of Potash	200 ,, ...	178 ,,
Sulphate of Lime	400 ,, ...	367 ,,

In this compost there are 30 kilogrammes of nitrogen.

According to M. Ville's instructions I treated some second ratoons with acid phosphate of lime alone, and at the same time treated a patch of the same ratoons with farm-yard manure.

At crop time the part which had been treated with farm manure looked better than that treated with phosphate; at the scale, however, one hectare of the canes treated with phosphate of lime returned 20,175 kilogrammes (about 20 tons), whilst the hectare treated with farm manure returned only 18,240 kilogrammes (about 18 tons).

Regarding the duration of the action of the chemical manure we can only supply incomplete estimates. Verbal reports assure us that where the chemical manure has been used on plant canes the first ratoons promise good returns.

On M. Bentier's plantation especially, only the ratoons of those patches of cane which had been treated with chemical manure appear to have been able to resist the dryness.

At Mahault Bay the ratoons treated with chemical manure are the most beautiful; but those canes to which farm-yard manure has been applied also look well.

Notwithstanding these appearances, M. Ville thinks it will be needful to add manure to the soil the second year. He fears that the potash would not be in sufficient quantity in the compost applied the first year, for two crops. However, experience does not always justify the conclusions of science, and what we see of the effects of chemical manures on ratoons appears to lead to the hope that its application biennially will maintain the fertility of the soil. The annual use of the compost will certainly be preferable; this will be the *intense* culture—the most advantageous of all under all conditions.

To complete the observations which precede, allow me to cite a fact personal to myself, and which I will leave to your own consideration.

The land which I cultivate is of very medium quality. In May, June, and July, 1867, I treated 12 hectares with chemical manure, of which eight were plant canes and four ratoons. The 12 hectares (about 30 acres) produced 47,500 kilogrms. (over 47 tons) of good sugar. I will conclude by quoting some accounts given by M. Momblet, member of the Manures Commission in Martinique.

M. Lenard's plantation, treated with chemical compost, produced 7,000 kilogrms. (nearly 7 tons of sugar) to the hectare. A sterile patch belonging to M. Morin, which no manure seemed to suit, is now in full and beautiful vegetation. In M. Ruff de Lavison's estate there were bare patches because of the very bad quality of the soil, which when manured with chemical compost, were covered with beautiful canes.

M. Ville is constantly occupied in settling the nature of the manures most suitable for different cultures; and, with this end in view, he endeavours to determine by experiment the substance in the manure whose action preponderates over that of the three others. To this end sixty-three cases of manures of various compositions have been sent here for trial on the Coffee Tree, the Cacao, the Annotto, Maize, &c. Our colleague, the President of the Chamber of Agriculture at Basse-terre, was desired to take charge of the distribution of these. I need not recall to you how much we are indebted to M. Georges Ville for his generous sympathy and the constant care which he has exercised without intermission for three years, in the midst of labours of which a small part would be a task for an ordinary man.

It was M. Ville who in 1866 traced minutely the course which we should take, entering into detail regarding the operations needful to ensure success.

Thanks to his advice, by carrying out his theory of chemical manures, we have been able to prove that nitrogen does not hold an essential place in cane culture, and that the most important agent, the *dominante*, as it is called, is phosphoric acid. These two facts alone are of immense service to those who, using large quantities of compost, are thus able to save considerable sums, because the nitrogen, of which the quantity used is very limited, is much the most costly, and phosphate of lime, of which the proportion is much the largest, is so very abundant in nature that it is much the cheapest of the three agents needed.

To determine the quantities of these agents, M. Ville advised us to try various composts with progressive proportions of nitrogen, of which he wished us to trace the formula. These experiments are the base of the work, the results of which are now reported. M. Ville also prescribed various treatments of phosphate of lime, that we might be assured of the predominance of this agent and determine the proportion.

Some other questions have yet to be resolved, which M. Ville follows with indefatigable perseverance. Beyond the various formulas which are applied, he is seeking the means of prolonging the effect of chemical manures as far as possible in ratoons. Having been very successful in France in the beet root culture by the use sub-soil manures, he would wish us to see the same agents applied to the cane, which he believes would be with equal success, in the culture of ratoons.

In M. Ville's opinion, farm-yard manure and chemical compost should be the complement and auxiliary the one of the other. He has also often recommended the utilising of megass ash, of distillery lees, and of all the vegetable refuse at disposal, either burnt or thrown into the cattle pen in its original state.

(To be continued.)

"JELLETT'S SACCHAROMETER."—In the article on "The Improvement of the Polariscope," p. 484 of this number, Mr. Jellett of Dublin is credited with the "idea" on which M. Cornu and M. Duboscq have based the construction of what is called a new saccharometer. Something more than the "idea" is due to Professor Jellett, Fellow of Trinity College, Dublin, now President of the Royal Irish Academy. The instrument as improved by him was mentioned in vol. ii. of *The Sugar Cane*, p. 71, and is well known as "Jellett's Saccharometer."—*Ed. S. C.*

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

235. A. BUDENBURG, Manchester. *Improvements in Sugar Refining and Centrifugal Machines.* Dated January 24, 1872.

A peculiar construction of cover for centrifugal machines used in sugar refining, enabling steam and air to be admitted instead of water, whereby the process is more perfect.

326. G. FLETCHER, Derby. *The Evaporation and Granulation of Sugar.* Dated February 1, 1872.

The bottom or bottom and sides of pan is or are jacketted, and the steam drum is welded and fixed by a screw nut on the end of its spindle. The condensed water is made to pass from the drum by its own specific gravity, and thence through the jacket of the pan to the condensed water box. For boiling or concentrating at a lower temperature and to obtain a larger grain and assist evaporation, a lower or less pressure of steam is employed. The liquor or syrup is agitated by a suitable arrangement. Two or more of the improved pans being provided, with gutters round the rims, may be used to supersede the ordinary reach, and boil solely by steam. The pan may be used either as a vacuum pan or as a still, by covering it with the usual vacuum pan or still-head. The inner surface of the pans and outside of the drum may be coated with copper, nickel, tin, or other metal capable of resisting acids.

Correspondence.

TRIBASIC PHOSPHATE OF AMMONIA AS A PURIFYING REAGENT.

AVON HOUSE, DULWICH COMMON,
LONDON, S. E., 5TH AUGUST, 1872.

TO THE EDITOR OF "THE SUGAR CANE."

SIR,

In your last number of *The Sugar Cane*, at page 409, tribasic phosphate of ammonia as a purifying reagent is spoken of as *new.*

I patented its application to sugar manufacture and refining, both in the United States and Cuba, in 1862. The date of my American patent is 5th August, 1862.

In the *Journal des Fabricants des Sucre*, of 22nd February, 1863, is an article by Mr. Ramon de la Sagra, in which this is mentioned.

I am, Sir,
Your obedient Servant,
EDWARD BEANES.

The following is a translation of the extract above alluded to:—

"I formerly made it my task to relate with impartiality the facts relative to the introduction of the use of bisulphate of lime into the Cuban sugar factories. Following the same rule, I must say that the first document, to my knowledge, relating to the use of sulphurous gas for the clarification of juice was a paper on the subject in the *Journal de la Marine* of the 20th June, 1862, consequently four months before the notice transmitted by Mr. Dumas to the Academy of Sciences, the 6th of October last. By this publication, of which I informed the said Academy the 10th and 24th of November, it was shown that a demand for a patent was made at the Patent Office in Washington, by Mr. Edward Beanes, in 1862, for the use of phosphate of ammonia conjointly with sulphurous acid, or bisulphate of lime, for the clarification of saccharine juices defecated by lime; the introduction by Mr. Beanes into Cuba of an apparatus for the production of sulphurous gas was detailed, its employment in the juice, the valuable results obtained in five large factories in Cuba during the crop of 1861-62; and, in conclusion, the satisfaction expressed by the proprietors from the use of a method which reduced the expense of the bisulphate, and prevented the disappointment in its purchase from the frauds which were practised."

"In a former communication (10 Nov., 1862) I called attention to the approximation which had struck me between the idea of Mr. Edward Beanes relative to the use of phosphate of ammonia for the perfect purification of saccharine juices, and the use of carbonate of ammonia, which had recently been recommended by M. Gérard to precipitate the sulphate of lime carried into the syrups from juice, even of the cane. The solubility of this alkaline base, which does not contain any other alkali, offers the great advantage of causing it to disappear from the liquids after its action, without the need of any reagent."

"Paris, 17 Feb., 1863."

MAURITIUS.

(From Licht's Monthly Circular.)

Exports from 1st August to 26th June.

	1871-72. Tons.		1870-71. Tons.		1869-70. Tons.
To England..........	43,609	..	19,553	..	39,087
,, France	13,886	..	6,379	..	11,155
,, Australia	27,418	..	36,508	..	45,568
,, Bombay..........	23,965	..	15,911	..	29,207
,, New Zealand......	3,207	..	3,656	..	3,098
,, Cape of Good Hope..	1,064	..	1,903	..	2,331
,, Other Ports	6,083	..	804	..	1,451
Total..........	119,232		84,714		131,897

HAVANA AND MATANZAS.

Exports from the 1st of January to the 5th of July.

	1872. Tons.		1871. Tons.		1870. Tons.
To United States of N. America ..	146,971	..	121,080	..	127,119
,, Great Britain	101,192	..	53,082	..	136,731
,, France	15,321	..	8,181	..	36,827
,, Spain......................	24,780	..	30,639	..	41,761
,, Northern Europe............	9,921	..	5,870	..	7,724
,, Southern Europe............	182	..	325	..	3,090
,, Other Countries	4,183	..	2,107	..	6,082
Total......	302,550		221,284		359,334
Stocks in Havana and Matanzas ..	120,177	..	113,774	..	117,331

JAVA.

Exports in First Three Months.

	1872. Tons.		1871. Tons.
Through Government	18,825	..	18,864
Private	28,229	..	41,179
Total	47,054	..	60,043

STOCKS OF SUGAR IN THE CHIEF MARKETS OF THE WORLD ON THE 1ST JULY, IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	1872.	1871.	1870.
Great Britain	102	127	126
France	43	82	75
Germany (Zollverein)	4	23	9
Holland	43	42	50
Six other Ports	4	4	5
Stocks in Europe	197	265	233
„ United States	108	108	126
TOTAL	305	373	359
Havana and Matanzas	120	114	117
TOTAL	425	487	476

CONSUMPTION OF SUGAR IN EUROPE AND THE UNITED STATES, FOR THE THREE YEARS ENDING 30TH JUNE, IN THOUSANDS OF TONS.

	1872.	1871.	1870.
Great Britain	699	708	657
France	283	282	308
Germany (Zollverein)	206	219	212
Holland	23	26	31
Six other Countries	94	106	110
Total in Europe	1,305	1,341	1,312
United States	564	495	460
TOTAL	1,869	1,836	1,772

SUGAR STATISTICS—GREAT BRITAIN.

To 17th August, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	29	4	4	29	65	60	57	9	11	49	126	149	40	6	9	27	81	114
British East India	5	..	..	..	5	6	9	4	..	..	13	6	7	7	..	..	14	17
Mauritius	3	1	..	2	5	4	12	4	12	7	36	13	11	3	14	8	36	13
Cuba	3	6	1	27	38	24	3	11	14	48	76	45	3	6	13	26	48	34
Porto Rico, &c. ..	3	4	..	4	11	7	4	12	..	7	23	21	2	9	..	4	15	19
Manilla & Java ..	10	3	..	2	15	30	17	9	2	9	37	34	20	16	2	8	45	45
Brazil	1	12	2	4	19	20	6	37	19	17	69	45	5	32	8	19	64	40
Beetroot, &c.	2	..	..	..	2	8	14	8	4	32	58	104	18	10	6	36	70	109
Total, 1872 ..	55	31	7	66	160	160	122	94	52	170	438	417	106	89	50	129	376	391
Total, 1871 ..	73	35	9	43	equal.		139	82	44	152	21 increase		135	80	40	136	15 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

The consequences of the extreme prices which prevailed in this country, some time ago, are now being felt in the remarkable changes shown by the sugar statistics of the month. Stocks, in the Four Ports, have increased 46,000 tons during the past month, and are now very nearly the same as last year. Imports have increased nearly 40,000 tons during the month, total imports being now 21,000 tons above those of 1871; this is the more remarkable inasmuch as there is a decrease in the import of beet sugar, in the same period, of 45,000 tons. Deliveries are 15,000 tons below those of last year; this is not entirely to be attributed to diminished consumption, but rather to the fact that refiners and the trade are buying only for immediate wants, and that the stock of duty paid sugar in the country is unusually small.

Prices have of course declined proportionally to the increase in stocks. No. 12 Havana afloat is quoted at 27s. 6d. to 28s. per cwt. Good refining Cuba Muscovados, 26s. Middling to good brown Bahias and Pernambucos, 21s. to 23s. These prices are about 1s. 6d. per cwt. below those of last year at same date, and show a general reduction of 3s. 6d. per cwt., from the highest point in the middle of June. Refined goods have participated in the decline, Common Refined Lump is worth 39s. 6d. to 40s., in London. The average duty paid price of refining qualities of British plantation is 30s. per cwt., a rather higher figure than at the same date in 1871; showing probably that the average quality now on the market is superior to that on offer last year.

About this time of the year, or earlier, imports generally begin to decline, so that with average deliveries there is little reason to expect further increase of stocks. Prospects of future crops, continental and colonial, are reported to be generally favourable to a large yield, but it is too early for anticipations to be of much value.

THE
SUGAR CANE.

No. 39. OCTOBER 1, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

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CHEMICAL MANURES FOR CANE CULTURE.

Continued from page 494.

M. GEORGES VILLE'S APPENDIX TO M. DE JABRUN'S REPORT.

The report, a translation of a greater part of which was given in the last number of *The Sugar Cane*, appears to have been forwarded by the President of the Commission to M. G. Ville, who comments upon it at length in his appendix. In alluding to the advice which he addressed to the Council General of Guadeloupe, in 1866, when chemical manures were first introduced, M. Ville repeats some observations then made:—

Chemical manures are certainly destined to become the chief agents in colonial agriculture, because more than any others they allow of the greatest yield being obtained without exhausting the soil, and because in the colonies the production of manure must always remain below the exigencies of the culture. Therefore I propose the trial of these new agents in two different conditions:

1st. As the only manure;
2nd. As the complementary manure.

In both cases the same rules must be followed;—return to the soil more than you take from it; determine by experiment the *dominante, i.e.*, the ingredient in the complete manure which has most effect on the cane, and also the quantities of the other ingredients from which, when compounded, the maximum of crop can be obtained with the minimum of expense.

Three years have passed since the above was written and one portion only of the experiments recommended has been carried out, the result of which has been shown by M. Jabrun's report. These experiments have proved that phosphate of lime is the *dominante* of the cane, that this plant requires a moderate supply of nitrogenous matter, and that a manure compounded from the following formula suits it well:—

Complete Manure No. 5.

	To the hectare.			
	Quantity.		Price.	Expense.
Acid phosphate of lime ..	600 kilogrms.	=	96 fr.	228 francs.
Nitrate of potash	200 ,,	=	124 fr.	
Sulphate of lime	400 ,,	=	8 fr.	
	1,200 kilogrms.			

(about 1,069 lbs. to the acre, at a cost of £3 14s. 0d.)

I could have wished that some experiments had been made with 1,800 and 2,400 kilogrms. of manure to the hectare, but the expense has deferred the realization of my wish. I recommended that ratoons should be manured every year, but the planters have manured them only every other year from economic motives. As to steam ploughing [which M. Ville had advised], it had been unanimously declared to be impracticable.

But the experiments have been tried, and facts have spoken; chemical manures have been proved superior to all others, although the returns have not attained the limits to which it is certainly possible for them to be carried, but new life has been infused into the colony, which promises further progress.

M. Souques, director of the great factory of Arboussier, comprehended at a glance that it was more advantageous for him to draw his supplies of canes from lands in his immediate vicinity than to look for them at a distance, and that therefore it was desirable that the crops should be doubled, tripled, or quadrupled. To this end he is using the needful appliances. Steam ploughs, and chemical manures in large proportions, are now acting to admiration. Before six months have elapsed we shall be able to fix the limits of the yield of cane as we have already done the formula of the most efficacious manures.

While experiments were being carried on in Guadeloupe, some trials were made in Martinique—the former by a Commission the conclusions of which have been published, the latter by private enterprise. The accounts from the latter, although couched in very moderate language, appear to reflect the opinions which certain of the agricultural press of France have spread against chemical manures. One general fact, however, has been gathered from these trials: the proportion of nitrogen which was required in Guadeloupe appears to be insufficient in Martinique.

M. de Listé, who has used chemical manures for many years, to which he owes very gratifying success, has increased the proportion of nitrate of potash from 200 to 300 kilogrms. per hectare (178 to 267 lbs. per acre). He thus wrote me under date the 2nd of June:—

"Ever since your articles have been published, I have been convinced of the value of your statements. Not knowing to whom to address myself to obtain practical direction I had suffered the pains of Tantalus, when the publication of your letter to M. Borde, President of the Chamber of Commerce, freed me from my dilemma. I thence drew the following formula, which I have always employed:—

	To the hectare.		
	Quantity.	Price.	Cost.
Acid phosphate of lime..	600 kilogrms.	= 96 fr.	290 francs.
Nitrate of potash	300 ,,	= 186 fr.	
Sulphate of lime	400 ,,	= 8 fr.	
	1,300 kilogrms.		

(say 1,158 lbs. to the acre, at a cost of £4 14s.)

"I have made no comparative cultivation nor field experiments; I have not weighed the canes; it would therefore be impossible for me to furnish precise results, but I can affirm that with the same expenses of cultivation, chemical manures have increased my returns 40 per cent."

I find in the *Journal des Antilles* of the 4th August, a similar declaration to the preceding, coming from the Honourable M. Lenard, one of the most intelligent planters in the island:—

"Two patches of plant canes manured in April, 1868, with manure No. 4,* yielded me in 1869 42,000 lbs. of sugar, or thirty-eight tierces."

Another portion of a cane patch manured partly with guano and partly with chemical manure, produced 18,000 lbs. of sugar. I further proved that the ratoons from canes manured with M. G. Ville's chemical compost are so vigorous that they appear as though remanured, and I am disposed to dispense with further manuring.

On the plantation of Vauclines, the canes treated with complete manure, No. 4, resisted the drought; they preserved an intense green, whilst canes of the same kind around them, treated with other manure, were parched up.

More complete accounts from the island of Reunion appear to show that the proportion of 200 kilogrms. of nitrate of potash may be exceeded with advantage. In Reunion there are a great variety of climates, because of the different altitudes of the different parts of the island. M. Frappier, to whom I am indebted for these accounts, says that 50 to 60 kilogrms. of nitrogen per hectare (say ½ cwt. to the acre) produced a marked effect in the higher parts where the temperature is lower.

Further, from the fact that 200 kilogrms. (178 lbs. per acre) of nitrate of potash produced in Guadeloupe the maximum effect when combined with 600 kilogrms. (535 lbs. per acre) of acid phosphate of lime, we are not sure that if the proportion of the latter had been increased a proportionate increase in the nitrate of potash would not have produced a corresponding increase in the yield. Then the question is, to what limit can the respective

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* The following is the formula:—

	To the hectare.		To the acre.
Acid phosphate of lime	600 kilogrms.	=	535 lbs.
Nitrate of potash	400 ,,	=	356 ,,
Sulphate of lime	400 ,,	=	356 ,,
	1,400 ,,	=	1247 ,,

quantities of phosphate of lime and nitrate of potash be carried so that the increased return shall continue to be in greater proportion than the increased expense?

In the limited regions where the culture of the cane becomes uncertain for want of heat, would not the addition of a small quantity of sulphate of ammonia, by stimulating the formation of leaves during the first period of the growth of the plant, have a beneficial effect?

These questions can only be resolved by experiment, but in order that fresh trials shall produce their fruit, it is desirable that they should be conducted on some uniform plan. The following new formula of manures are what I should recommend to be tried:—

First Series, in addition to those already published.

			To the hectare.	Nitrogen.
No. 1	Complete manure,	No. 5..	1,200 kilogrms.	.. 28 kilogrms.
,, 2	,,	No. 5..	1,800 ,,	.. 42 ,,
,, 3	,,	No. 5..	2,400 ,,	.. 56 ,,

Second Series.—No. 1. Complete Manure No. 8.

	To the hectare.		
	Quantity.	Price.	To the acre.
Acid phosphate of lime....	1200 kilogrms.	= 192 fr. ..	1069 lbs.
Nitrate of potash	300 ,,	= 186 fr. ..	267 ,,
Sulphate of lime	300 ,,	= 6 fr. ..	267 ,,
	1,800	384 fr.	1603 ,,

42 kilogrms. of nitrogen per hect. (37 lbs. per acre.)

2. Complete Manure No. 9.—for cold regions.

	To the hectare.		
	Quantity.	Price.	To the acre.
Acid phosphate of lime..	1,200 kilogrms.	= 192 frs. ..	1069 lbs.
Nitrate of potash	400 ,,	= 248 frs. ..	356 ,,
Sulphate of ammonia ..	50 ,,	= 22·50 frs. ..	44 ,,
Sulphate of lime	300 ,,	= 6 frs. ..	267 ,,
	1,950 kilogrms.	468·50 frs.	1736 ,,

56 kilogrms. of nitrogen per hect. (50 lbs. per acre.)

As a general rule, like all plants of rapid growth, the cane requires the phosphate of lime in its most soluble form, there are cases, however, where the precipitated phosphate, less soluble than the acid phosphate, may be substituted with advantage; this is when the soil contains humid matters or vegetable detritus in abundance. In Cuba, in the low lands of Martinique, and in certain districts of Reunion, soil of this nature is abundant. For this special case divers experiments made in France, without being decisive, appear to favour the use of phosphate less soluble than the acid phosphate. It is then very urgent that for this case special trials should be made of the complete manure No. 10.

Complete Manure No. 10.

	To the hectare.			
	Quantity.		Price.	Expense.
Precipitated phosphate..	1,200 kilogrms.	=	240 frs.	494 frs.
Nitrate of potash	400 ,,	=	248 frs.	
Sulphate of lime	300 ,,	=	6 frs.	
	1,900 kilogrms.			

(This would be about 1,690 lbs. of the compost to the acre, costing say £8.)

I fully hope that if successive experiments were made with these manures, not only on plant canes but also on ratoons, that in two years the practice of each country would be settled on the best conditions for the production of the cane in all the districts where this valuable culture is practicable, and what I say of the cane applies to all colonial products, coffee, cocoa, tobacco, maize, &c., all threatened with decline, and which all may again become prosperous by the proper application of manures which it is necessary in each case should be chosen by experiment.

ON THE MANUFACTURE OF SUGAR FROM THE SUGAR CANE, AND THE MACHINERY EMPLOYED THEREIN.

(Continued from page 483.)

Part XI.

It will be seen that the Demerara system of manufacture just described, though capable of producing a sugar of attractive appearance and good quality, is yet far from being perfect.

The use of the Jamaica train for effecting the concentration of the juice up to 25° or 27° Baumé, though not nearly so prejudicial as its employment for finishing the concentration, is nevertheless attended with a certain degree of injury to the colour and of transformation of crystallizable sugar into uncrystallizable.

Yet in the Demerara system of manufacture, the preliminary concentration is always effected in the Jamaica train, the advantages which would result from abandoning it, and conducting the whole of the concentration of the juice, preliminary as well as final, in the vacuum pan, not being considered sufficient to warrant the considerable additional expense which would thus be incurred for more powerful vacuum pans, air pumps, and boilers, also for increased consumption of fuel, &c.

While the reasons just given preclude the use of the ordinary vacuum pan except for the concluding stage of concentration, a modified arrangement of vacuum pan, known as the "*triple effet*" pan, is in very general use in the French colonies and in Egypt, and also, though less generally, in Cuba, Mauritius, &c., for effecting the preliminary stages of this process.

The main objects of the *triple effet* pan are economy in fuel and in condensing water. It consists of three separate evaporating pans. The first of these, in which there is little or no vacuum, is heated by steam at a pressure of some five or six pounds, sometimes more. The exhaust steam from the cane crushing and air-pump engines is often used for this purpose. The steam given off by this first pan is used for heating the second, which boils at a considerably lower temperature, as there is in it a vacuum equal to some twelve or fourteen inches of mercury. Thus the liquor in the second pan forms, in fact, the condenser for the vapour given off by the first. In like manner the steam from the second pan boils the liquor in the third, in which as good a vacuum as possible is maintained. The vapour from the third pan is condensed by a separate condenser, while the pan itself is in communication with an air-pump which maintains the vacuum.

Supposing the first pan to have a very slight vacuum, and to boil at 200° Fahrenheit, and the third, having a pretty good vacuum, to boil at 150°, the boiling point of the second pan should then be about 175°. The steam of the first pan would thus be 25° hotter than the liquor in the second, a sufficient difference to produce pretty brisk boiling, while the steam of the second pan would be 25° hotter than the liquor of the third.

Evaporation will proceed at much about the same speed in each of the three pans. Theoretically, it ought to proceed at just the same speed, for the heat of each pound of steam condensed is theoretically capable of transforming another pound of water into steam; but practically there is some little loss in the transmission of the heat.

The amount of work done by a *triple effet* apparatus is only equal to that which would be done by a single one of the three pans, supposing it to have as good a vacuum as the third pan of the series, and to be heated by steam at as high a pressure as that supplied to the first. At first sight this looks an anomaly, since the three pans have three times the capacity, and three times the heating surface possessed by one of them; but a little consideration will show that the speed of evaporation is dependent upon the difference between the heat (sensible heat) of the steam, and the temperature of the boiling liquid.

Now, supposing the steam first employed to be at a pressure of about four pounds, and a temperature of about 225°, while the liquid boils at 150°, we shall then have a difference of sensible heat between the steam and the liquid of 75°, if the evaporation is being conducted in a single vessel. If, however, the evaporation is carried on in a triple effet, the liquid in the first vessel will boil at 200°, so that there will be only 25° difference between the temperature of the steam and that of the liquid. In like manner, the steam arising from the first pan will have a temperature of 200°, whilst the liquor in the second pan, which it heats, will boil at 175°, so that we have again a difference of 25° between the temperature of the steam and the liquid in the second pan; similarly the steam from the second pan will have a temperature of 175°, while the liquid in the third boils at 150° or 25° less than the steam heating it.

Thus the difference between the temperature of the steam and the liquid in each pan of the *triple effet* being only 25° or one third of what it would be if the whole operation were carried on in a single vessel; consequently, each pan will only do one-third of the work, and the three together only as much as a single one of them having a good vacuum, and heated by high pressure steam.

It is evident, then, that the *triple effet* is a very costly apparatus as compared with the amount of work it can get through, since three evaporating pans are used to do the work of one.

It is, however, economical both in fuel and in consumption of water. The only fresh steam used is that supplied to the first vessel, and this as we have shown above is only one-third of that needed to effect in a single vessel the total evaporation accomplished in the three vessels of the *triple effet.*

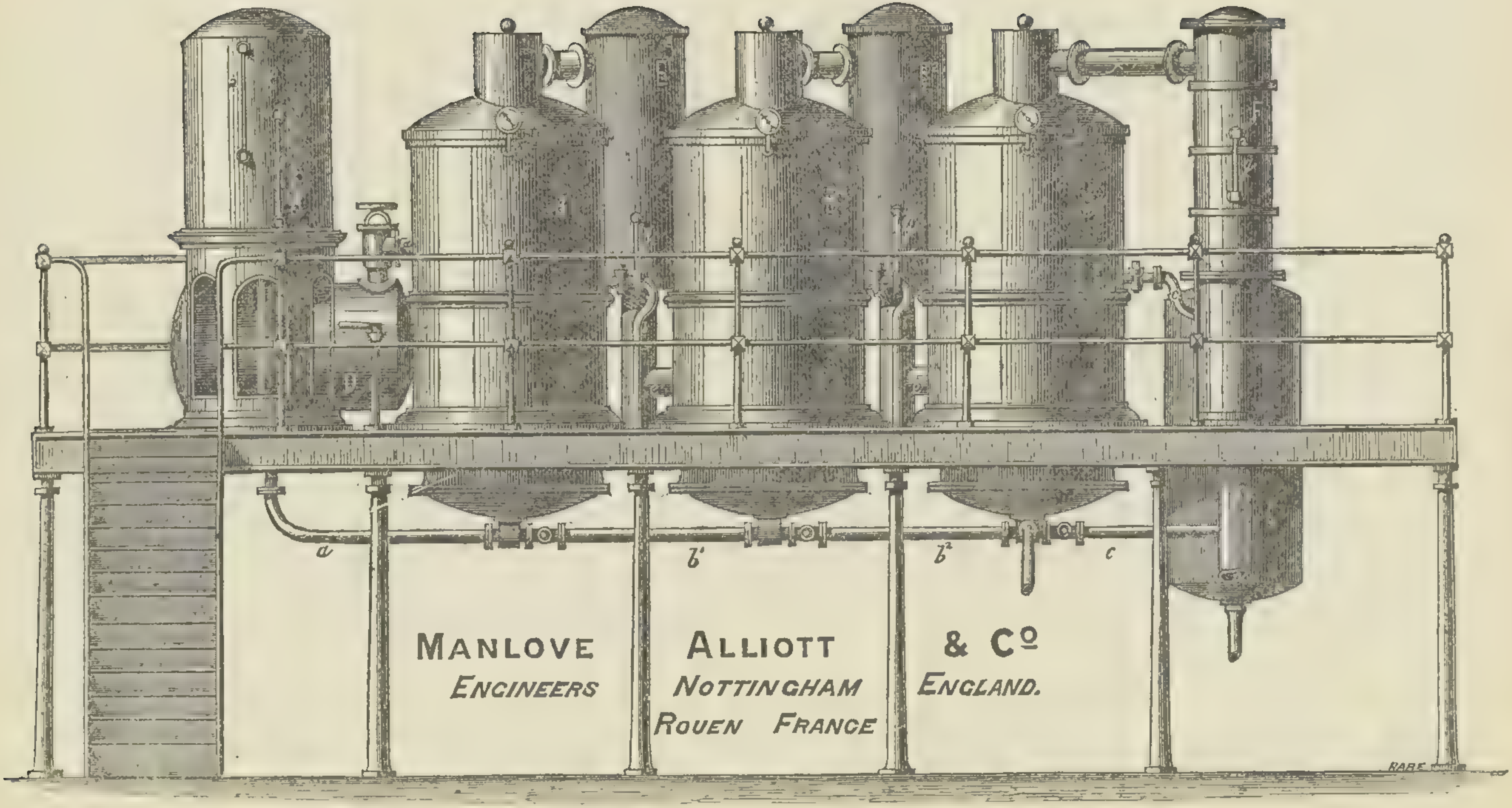
In like manner, only one-third of the condensing water is needed that is required for a similar evaporation in a single pan. This is at once evident because the vapour from the first pan is condensed in heating the second, and that from the second in heating the third, so that only the vapour from the third pan has to be dealt with in a separate condenser. This economy in consumption of condensing water is often of great importance, since the manufacture is usually carried on in the dry season, and in many parts of the world it is then difficult to obtain a regular and adequate supply of it.

The economy of fuel is to some extent counterbalanced by the fact that with the ordinary construction of *triple effet* pan, it appears to be necessary to filter the juice through animal charcoal before passing it to the *triple effet* otherwise the deposit of lime on the heating surfaces takes place so rapidly as very seriously to interfere with the working. After deducting the fuel required for reburning the char, there is however, a considerable economy in fuel remaining. Even where animal charcoal is employed, lime deposits to a considerable extent, and must be removed at intervals, an operation which gives a considerable amount of trouble.

The juice to be evaporated passes first into the first pan. There is not usually sufficient vacuum in the pan to draw it up so that it must be either forced into it by a pump or *monte-jus*, or run into it from a higher level. A pipe and cock enables the liquor from the first pan to be drawn into the second as needed, the better vacuum in the second pan causing the liquor to flow into it very readily. From the second the liquor is drawn in like manner to supply the third.

Thus the densest juice is found in the third pan, the one boiling at the lowest temperature. This is theoretically right, and perfectly in accordance with the principles which, as we have stated, lie at the foundation of all scientific sugar manufacture; yet it has its practical difficulties, for as a consequence of it, the concentration cannot be finished, sugar cannot be boiled to grain in the *triple effet*. The difference in temperature between the heating steam and the boiling liquor is not great enough to produce practically efficient evaporation in highly concentrated liquor. Yet the order of the introduction of liquor into the pans cannot be varied without much additional complication in the machinery, and practically it never is varied.

The *triple effet* is employed for the preliminary evaporation, and the final concentration is conducted in a separate vacuum pan.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ENGINEERS NOTTINGHAM ENGLAND.
ROUEN FRANCE
RABE

Though the *triple effet* has the advantages of economy in fuel and water, and of evaporating at a low temperature, it has yet some disadvantages. Where it is employed the whole machinery is of necessity most costly; char filters, char-kilns, and a separate vacuum pan being required, in addition to the ordinary crushing and defecating apparatus, and the *triple effet* itself. Much labour is required, and then although it evaporates at a comparatively low temperature, it yet keeps the cane juice for a long time exposed to heat, and though the heat employed is moderate, it is yet sufficient to do injury to such an unstable compound as cane juice, when exposed to it for hours, as it of necessity is in the *triple effet.*

The Concretor is sometimes employed to concentrate juice to be finished in the vacuum pan, and from what we hear from those who have employed both systems, juice thus prepared is brighter and better than that prepared in the *triple effet,* while the use of the Concretor does not necessitate the employment of animal charcoal.

We annex a sketch of a modern arrangement of *triple effet* pans, in which a steam receiver and a *mont-jus* are also shown on the same iron framing. B^1 B^2 B^3 represent the three pans, connected to the measure marked A, by the pipe marked a, and to one another by b^1 b^2; the third pan being also connected to the *mont-jus* C by the pipe c.

D, is a steam receiver communicating through the pipe d with the steam space of the first pan. E^1 E^2, are receivers for the vapours from B^1 B^2, which pass through the pipes e^1 e^2, into the steam spaces of B^2 and B^3 respectively; these receivers act also as tell-tales, having glass gauges attached to them for that purpose at g^1 g^2. F is the condenser connected to the third pan by the arm pipe f^1, and communicating with the air pump through the pipe f^2; the upper part being fitted with glass gauge, acts also as a tell-tale to the third pan.—*British Trade Journal.*

(To be continued.)

THE PROGRESS OF THE SUGAR BEET CULTIVATION FOR THE MANUFACTURE OF SUGAR WITHIN THE UNITED STATES.

By C. A. Goessmann, Ph.D.

1830.—Messrs. John Vaughan and James Donaldson, of Philadelphia, it is stated, formed the first company (in Ph.) for the manufacture of beet sugar. They failed on account of want of information. The average yield of sugar from beets was then only from 4 to 5 per cent. in Europe. (Goess.)

1838.—David Lee Child, of Northampton (Mass.), Hampshire Co., engaged that year in some experiments. He produced 1,300 lbs. of sugar. No details about his experiments are known to me, except the statement that he produced 13 tons of beet roots per acre, at an expense of 42 dollars.

For twenty-five years following no experiments, it appears, were undertaken; at least there are no records of results to be found. Three states entered subsequently upon experiments, and are, judging from recent statements, making rapid strides towards complete success. Illinois, Wisconsin, and California; I propose to sketch the movements in each state successively.

Illinois.

1863.—Gennert Brothers (from Braunschweig, Germany) of New York City, bought a tract of land (2,400 acres) at Chatsworth, in Livingstone Co., Illinois, on the line of the Illinois Central Railroad. The works were constructed with the view of treating fifty tons of roots per day. Want of capital caused a delay in 1864. The projectors subsequently organised into a stock company, known by the name of the "German Beet Sugar Company, at Chatsworth." The history of this enterprise is remarkable on account of a series of failures, partly due to *unfavourable* seasons and *inferior* beets, and partly to an *ill-chosen* location for the field of operations. The serious influence of a virgin soil, rich in humus and salines, on the quality of the beets, and a frequent want of water, caused the final removal of the factory, etc., to Freeport, Ill., on the Yellow Creek (1870). The causes of this first failure are at present so well recognised, and the confidence in a financial success under more favourable condition is so strong, that increased accommodation for more extensive operations at Freeport are considered a safe investment on the part of the main operators, Mr. Rosentiel and his associates, of Chatsworth.

In 1866, 400 acres of sugar beets were reported under cultivation, yielding 4,000 tons of roots, and producing 27,000 lbs. of sugar, which entered the Chicago market, June, 1867. The beets were of inferior quality.

1867. From 8,000 to 10,000 tons were grown.

1868. Six hundred acres of beet roots were under cultivation. Five months drought injured the crop most seriously; they obtained but 5,300 lbs. of beet roots per acre (about $\frac{1}{5}$ to $\frac{1}{6}$ of an ordinary crop). The beets contained but 8½ per cent. of sugar, and 4 per. cent. of sugar was secured. 600 barrels of sugar were sold in that year.

1869.—Seven weeks of uninterrupted rain in May and June destroyed the young plants (by *washing* away the soil and rotting the plants), with the exception of 100 acres. Subsequent drought and early frost reduced the remaining crop to 300 tons of beet roots; water failed again.

1870.—The crop reached 9 tons of roots per acre; 330 acres were under cultivation with sugar beet plants, of which again 150 acres were an entire failure on account of drought; 200,000 lbs. of sugar were produced in 1870. An attempt in 1869 to sink a well for an increased supply of water failed at 1,020 ft. depth. Messrs. Bunn, Case, and Rosentiel moved that year part of the *machinery* to *Freeport*, apparently with full confidence in their final success. A friend of mine, quite familiar with the practical working of the beet sugar industry, wrote me in 1867, that the establishment at Chatsworth was ill proportioned for the work designed, and the general management open to serious objections; he did not say who was to blame.

Wisconsin.

1867.—Messrs. Bonesteel and Otto, Germans, of Fond du Lac, Wisc., decided to enter upon the manufacture of beet sugar. They organised a company with 12,000 dollars capital, and subsequently constructed works to treat 10 tons per day. At first but 130 acres of beet root plants were taken under cultivation.

1869.—Want of capital limited their operations, which on the whole must have been satisfactory, for a Philadelphia capitalist proposed to advance the money required; at the same time offers were made to them by General C. F. Hutchinson, of San Francisco, who had organised, at the suggestion of Mr. Bonesteel, in that city, a company with 250,000 dollars capital for the manufacture of beet sugar. Messrs. Bonesteel and Otto accepted the offer from California, left Fond du Lac, and entered in the spring 1870 into the recently organised Alvarado Beet Sugar Company.

1870.—Another beet sugar company, a *co-operative enterprise* of German farmers, began operations at Black Hawk, Sauk Co., Wisconsin, under the name of First Sauk Sugar Company. Their works were capable of treating daily ten tons of beet roots. They cultivated (1870) two hundred acres of sugar beets, and made 40,000 lbs. of very good (A 1) sugar, when the ponds on which they relied dried up, and compelled them to feed their cattle on the root crop. The factory is, as I am informed, located without any particular advantages of transportation or water supply.

California.

1860.—Mr. Speckman, a sugar refiner, imported sugar beet seeds from Germany, and induced farmers in the vicinity of San Francisco to cultivate them. The beet roots proved to be too saline, and thus unfit for sugar manufacture; so he gave up the idea. Mr. Gordon, of San Francisco, a few years afterwards, proposed to try it again. He went for this purpose with Messrs. Speckman and Wentworth to Europe to study the industry. He has since died.

1869.—Mr. Wentworth made the first few hundred pounds of beet sugar, which result encouraged capitalists to form, under

General C. J. Hutchinson's management, the Alvarado Sugar Company, in Alameda Co., California.

1870.—They began operations in November. The works of this company are calculated to treat every day from 50 to 60 tons of roots. They work the pulp of the beets with *centrifugal apparatus.* They propose to cultivate eventually 800 acres of sugar beets. In 1870 they cultivated 480 acres with bad success, for drought injured the crop seriously. The yield during 1871 was about 15 to 16 tons per acre. Over 1,000,000 lbs. of sugar were produced from the crop. The capital of the Alvarado Company is 250,000 dollars. Messrs. Bonesteel and Otto have been partners in the business since 1870. The prospects of the company are reported as being very satisfactory.

1869.—Sacramento Valley Company began operations. The crop failed in 1871 to a considerable degree. They secured that (first) year about 2,000 tons of roots, partly of a very inferior quality. Robert's *diffusion* apparatus are employed, and the works are calculated for 50 to 60 tons of roots per day.

The St. Clara Valley Agricultural Society organised the third California company, on the 29th of December, 1870, with a capital of 200,000 dollars. The factory is located at San Jose. No reports have yet appeared.

Appendix.

The National Department of Agriculture at Washington have sent beet root seeds to Chatsworth since 1867.

Professor Antisell wrote his report to the Commissioner of Agriculture on the sugar beet cultivation and industry in Europe in 1867.

The State of Illinois passed in July, 1867, a law (which held good for but one year) that all machinnery used in the beet sugar industry should be exempted from taxation.

New Jersey and Massachusetts passed a law during the last session of their legislatures, 1871—1872, (for ten years from date), which exempts the capital, etc., engaged in the enterprise from taxation.—*American Chemist.*

SUBSTANCE OF THE REPORT OF THE COMMISSIONERS FROM ANTIGUA

Appointed to enquire into the working of the Central Sugar Factories System in Martinique and Guadeloupe.

We arrived at Basse-terre, Guadeloupe, on the 13th June, and proceeded without delay to the town of Point-à-Pitre, where the largest central factory, or usine, in the French islands is situated, the "Compagnie Sucrière E. Souques & Cie," commonly called "L' Usine d' Arboussier." This factory stands in the suburbs of the fine seaport of Point-à-Pitre, and is constructed upon the grandest scale, and is replete with all the improvements in machinery for the manufacture of sugar devised by modern science.

The cost was £216,000, and the usine, when a third mill now being put up is available, will be equal to an out-turn in the first six months of the year, of from 8000 to 10,000 tons of sugar.

It commenced operations in April, 1869. The first season was completed with part of the copper machinery not fitted up, and at no time was the usine supplied with sufficient canes to keep its mill going. The supply of canes is derived from both divisions of Guadeloupe, the volcanic and calcareous. From the former they are conveyed in large lighters towed by steam tugs; from the latter, by the tramway, several miles in length. The canes are carted by the planter to his nearest point, on the railway, or shore, and thence by the usine to the destination, where they are weighed by a sworn agent in the presence, if required, of a representative of the estate.

The planter receives the equivalent in money of 5½ per cent. of the weight of his canes of "*bonne quatrième,*" sugar equal in colour to No. 12 "Dutch standard," the price being regulated by the market at Point-à-Pitre, at the time the canes are delivered.

The process of sugar manufacture at this usine is as follows:—

The canes are brought by the planter to a siding of the main tramway on his estate. The wagon generally carries two tons of canes, and one mule on a good level ordinary tramway can draw easily two wagons. The wagon, when brought to the mill itself, conveys the canes to the rollers. The megass is elevated by power to a platform over the boilers. The juice on leaving the mill-bed falls through three strainers into a tank, which has a double bottom heated by steam. It is here treated with a little bisulphite of lime, and is then run into a *mont-jus*, which sends it up to the clarifiers where it is heated in the ordinary way and tempered with lime. From this it is passed to the charcoal filters through which it gravitates, and then passes by a gutter into a receiver. It is raised by a *mont-jus* into a cistern over the *triple effet*. From this cistern it gravitates into the *triple effet*, passing from the first to the second, and from the second to the third boiler, as the attendant wishes. When the syrup leaves the third boiler it is generally 25° Baumè, and it is immediately passed over newly reburned charcoal, and falls into another receiver, from which the vacuum pan takes it up and boils it to sugar. The first quality sugar is generally crystallized in the pan, and is then dropped into sugar boxes, which stand seven feet from the ground; under these boxes a little charging vessel runs on a railway that is hung from the bottom of the said boxes, and this vessel conveys the sugar over the centrifugals where it is cured. The molasses from this, when found in good condition, is boiled up with the syrup of the following day. When the molasses is thick and clammy it is boiled into jelly by itself and dropped into sugar boxes, and allowed to granulate for a number of days. This makes the second quality sugar, and the molasses from this, along with the skimmings and subsidings of clarifiers, goes to make rum. The juice that leaves the clarifiers does not pass over fresh charcoal but follows the syrup from the *triple effet*, thus assisting to wash out the sweets which may have been left by the syrup.

The figures following show the weight of canes delivered to the factory:—

	Tons.
1869	17,808
1870	42,808
1871	68,745

This year, notwithstanding the severe drought, the receipt of canes was upwards of 75,000 tons.

Thus, in the first three years, the growth of canes upon plantations under contract to the usine had quadrupled, and the management, accused at first of having established a factory in a district devoid of canes, has been compelled to erect a third large and powerful mill with its accessories to provide for the reception of the normal quantity of canes expected, viz., 100,000 tons per annum.

This factory pays 5½ per cent. for its canes, and the figures following show the financial results for the three years ending 1871:—

	Profit. £	Loss. £
1869	4385	—
1870	—	440
1871	28,899	—
	33,284	
Deduct	440	
Leaving	£32,844	

A profit of £7000 was expected in 1870. Severe losses sustained on produce shipped, owing to failures during the late war in France, and other circumstances connected with that trying and exceptional year, are assigned as the reason for the failure of profits of the usine, in 1870.

In 1870, 6096 tierces of sugar of 10 cwts. each, equal in round numbers to 3000 tons, were obtained from the 42,808 tons of canes received, or 7·12 per cent. of sugar.

Three per cent. of syrup was also obtained, which was converted into 117,620 gallons of rum, of an average centigrade strength of 60°, equal to $39\frac{31}{51}$ gallons per ton of sugar.

In 1871, 10,651 tierces of sugar, or 5325 tons, were obtained from the 68,745 tons of canes received, or 7·74 per cent., composed as follows:—

1st quality of sugar	6·24 per cent.
2nd and 3rd do.	1·50 ,,

A minimum average return of 8 per cent. is confidently expected when not less than 25 per cent. of plant canes are regularly forwarded from the contributory estates to the factory.

The superintendent in a report made to a general meeting of the shareholders, on the 24th April, 1872, and unanimously adopted, remarks that this factory was compelled after its second campaign to refuse the offer of fresh contracts, and to increase its working power 50 per cent. to enable the usine to keep pace with the rapid increase in the production of the estates engaged.

"But two years ago, says M. Souqués, a lack of canes was dreaded; now an excess of supply is to be feared."

This usine in April last, the third year of its existence, declared a first dividend of 24 per cent., exclusive of 4 per cent. carried to the credit of the Sinking Fund Account. The general manufacturing and working expenses of the usine, in 1871, amounted to £117,732. The sugar realized £141,754, the proceeds of rum were £12,275, equal together to £154,029, showing a profit upon a simple debit and credit account (without charging interest upon capital, wear and tear of stock, &c.,) of £36,297 upon a manufacture of 68,745 tons of sugar and 182,798 gallons of rum.

We had not the advantage of seeing this great laboratory at work, the operations for the year being ended.

The Commissioners observe here that the processes of manufacture both of sugar and rum in all the usines both in Martinique and Guadeloupe visited by them are more or less identical, the only perceptible difference being the adoption in the new factories of the appliances of modern science and improved mechanical and other arrangements. The clarification of the juice, its reduction to syrup at a low temperature, the perfect crystallisation and colour of the sugar, and a maximum return, are obtained by repeated filtration through animal charcoal, the *triple effet* and vacuum pan processes, and last of all centrifugal machines.

A great drawback at present to the *usine D'Arboussier* is the want of fresh water, salt water is obliged to be used, as also water derived from wells decidedly brackish. The injury to the boiler tubes and other machinery from using salt water has been so great that arrangements are now being made at a great cost to bring fresh water to the usine from the other division of the island.

We take leave of this palace factory with the remark that the proprietors of contributory estates as well as several shareholders with whom we had the pleasure of conversing expressed themselves perfectly satisfied with the present condition of affairs, and very confident as to the permanent success of the usine. The shares originally issued at 500 francs are now quoted at 1000 francs, but none are to be had. We were informed upon good authority that estates which before the establishment of usines were in debt, or constantly changing hands, were now in a flourishing condition, and that others which had almost fallen out of cultivation were now making excellent crops.

The island of Guadeloupe is divided into two parts by a narrow channel, called the Rivière Salcé, running N. and S. The western portion (Guadeloupe proper,) is of volcanic origin, is mountainous, well wooded, and abundantly supplied with water, its soil, resulting from the disintegration of trap and conglomerate, is generally of a stiff argillaceous nature.

The eastern portion is entirely calcareous; its surface is undulating, the hills nowhere attaining any considerable elevation, are generally cleared of wood. It suffers much more now from drought than the western part, the inhabitants deriving their supply of water chiefly from wells and ponds, as in Antigua; in fact, in its general features and climatal conditions it bears a considerable resemblance to that part of our island lying N. E. of a line drawn from Dickenson's Bay on the N. W. to Willoughby Bay on the S. E. It is in this portion of the island, called "Grande Terre," that the "Usines Centrales" are situated. Leaving Point-à-Pitre, the Commissioners traversed the island of Grande Terre in a N. E. direction to the small port of Le Moule at short distances from which are several usines constructed on a smaller scale than that of D' Arboussier. The country in this part of the island bears much analogy in its soil, climate, and general aspect, to the corresponding part of Antigua. The soil is generally a dark coloured loam, on a marly sub-soil overlying rocks composed of indurated marl and a limestone, made up of comminuted shells and coral. The water is derived from ponds, wells, and cisterns, there being no running water of any consequence. The canes appeared to be suffering from drought in the same degree as those of Antigua. We were unable to ascertain positively the amount of rainfall, as it does not appear to be the custom to have pluviometers on estates, as with us.

"Usine Zevalloz." The method of manufacture here was generally the same as at D' Arboussier. Charcoal filters, *triple effet*, vacuum pan, and turbines. There was, however, a feature which we did not observe at the latter place, viz., the employment of refrigerators for economising the water supply. These consist of high sheds open on all sides in which are placed strata of fascines. Over these is conducted the waste water which has served for condensation in the vacuum pans and percolating them it falls into a cistern underneath, its temperature reduced to [?] that of the atmosphere. It is thus rendered again available for condensing purposes. Zevalloz makes 2000 tons of sugar. It works night and day. It employs 140 hands by day and the same number by night. The greatest distance from which it brings its canes by rail is 3½ miles; they are carted by the planter to his nearest point on the railway, from thence at the expense of the usine. This railway with material cost between £1600 and £3200 per mile. The breadth between the rails is 1½ yards, and the speed attained 6 to 10 miles an hour. The usine Duckassaing is on the same principle and scale as that of Zevalloz. They both pay 6 per cent. of the weight of the canes.

The labouring population in this district has not increased since the establishment of central factories, about 50 per cent. of the hands of the separate sugar works, when these were abolished, were required to work the usines; the planter thus gaining 50 per cent. of the hands employed about the works. After crop many of the usine labourers assist in the cultivation of the estates, others till their own plots, being generally small land holders. In ten years the price of labour has augmented by three-eighths. Here again we were informed that estates within easy distances of the central factory, which were formerly in a chronic state of debt, are now clear, prosperous, and well cultivated. The appreciation by the planters themselves of the beneficial effect of the usines was evidenced by their continual desire to have the line of railway extended so as to enable them to forward their canes. At the commencement there was considerable difficulty in coming to an arrangement where proprietors were under engagements to consignees, but as the latter (here called commissionaires) were almost always residents, or represented in the island, they agreed to wait; the planters in the meantime paying a commission, as before, upon the quantity of sugar made at the usine from their canes, the Director being guarantee. In some cases the usine took up these debts. After the disconnection of the planters with the Commissionaires, the Colonial Bank advanced money, for the purposes of cultivation, at 6 per cent., the usine being security for their repayment.

We quitted Guadeloupe for Martinique, upon the 18th June, but our steamer having been in communication with St. Kitts and Trinidad, two ports declared infected on account of small pox, we were refused permission to land and were forced to proceed in the steamer. At each successive island the same ill-fate attended us, and we did not reach our destination at Martinique until the 1st July, when two of our number were enabled to land, Mr. Harman being compelled to return home. Martinique differs from Guadeloupe in having no calcareous formation, its origin is purely volcanic, and its physical geography, soil, and climate, &c., resemble those of the western half of the latter island. The rainfall appears to have been superior; during our stay it rained nearly every day.

The factories are situated principally on the N. E. of the island; there is only one on the S. W. side, close to St. Pierre, called La Riviere Blanche, which is newly established having only worked three weeks at the end of last crop. It has all the latest improvements in machinery and apparatus, is capable of making 2500 tons, and its cost, everything included, was £48,000. It consumes from 400 to 650 kilogrms. of coals to the 1000 kilogrms. of sugar made. The process is the usual charcoal filters, *triple effet*, vacuum pan, and centrifugals; it had not a sufficient supply of canes this year, but expects a large development of cultivation in the neighbourhood, chiefly by the small proprietors. This usine gives 6 per cent. for its canes.

We proceeded without delay to Fort de France. Near this town is the first factory established in Martinique by an Englishman, 25 years ago, Pointe Simon. It did not succeed well at first, in consequence of want of experience, defective machinery, &c., but is now paying well, it gives, however, only 5 per cent. of the weight of canes.

"Dillon." This factory is situated about three miles from St. Pierre, the works are well constructed and very compact, with all the latest appliances. The length of the building is 79 yards, breadth 41½ yards. It was in working order 18 months after it had been ordered in France. The machinery is by Lecointe and Villette, and the cost of the usine alone amounted to £44,000. The railway, which is 12 miles in length, has been very expensive, in consequence of some mistakes in its construction, as well as the marshy and unfavourable condition of the soil. This has crippled the company, but full confidence seemed to exist as to its ultimate success, and much clearing is being effected of the neighbouring low hills. This was its first year of full working order. It has four boilers, one *triple effet*, sixteen turbines, twenty filters. The scum is pressed and the cake used as manure. The specific gravity of juice was 9° to 10° Baumé; 1100 tons of sugar were made of the present crop, and ¼ ton of coal was consumed per ton of sugar. This usine made a profit this year of 250 tons of sugar, and 1000 casks of rum of 250 litres, each selling at 90 frcs.=£3 12s. per cask. The mean weight of canes was found to be equal to 28 tons per acre.

(To be continued.)

ON THE INFLUENCE OF FORESTS ON RAINFALL.

By Alfred Fryer.

(Continued from page 468.)

Few readers will have the opportunity or the inclination to peruse the four large folios which compose the Forest Conservancy Report of India, but it may be well to make copious extracts from the exhaustive observations on the influence of forests, by Mr. Dalzell, the Conservator of Forests, Bombay Presidency, which will be found in Part III, No. 10:—

"It has been said that to pursue the progress of man step by step in the destruction of forests would be to write the history of civilisation, as man is developed only at the expense of forest vegetation. Hence an endeavour has been made to establish it as a maxim that civilisation is antagonistic to the conservation of forests. When this sentiment, however, is analysed, it will appear pretty evident that it is more distinguished for brevity than for truth; for it is in civilised countries, such as Germany and France, that the conservation of forests is considered of vital importance to the progress and well-being of man, and that without forests, these would become like Asia Minor (the cradle of the human race), a country of ruined cities.

"It is only in the first step of civilisation that man is the enemy of forests. When the savage hunter begins to be dissatisfied with the precarious produce of the chase, and to perceive the advantages of a settled abode and a regular supply of food, he cuts down the trees which formerly sheltered him, and 'establishes a clearing.' The pioneers of the so-called civilisation may come from a country already civilised, and follow the example of the savage, but their acts and objects are the same as those of the savage, and a man cannot but feel that in becoming a pioneer of the so-called civilisation of a new country, he has gone back, for a time at least, into a state of semi-barbarism. Be this as it may, the gloomy and impenetrable forest disappears, and is replaced by smiling homesteads and waving crops; towns arise; the hunter becomes a farmer; food is multiplied; and the plough that prepared the land is made from the trees that lived on the ground which they are now made to tear up.

"But it has not always been with such justifiable motives as these, that man has devoted himself to the destruction of forests. Home bounties, and a desire of immediate gain, tempted our older North American Colonies (now the United States) to the most lavish destruction of the noble ship-timber which their forests formerly contained. This was cut down within a few years, and sold at a comparatively low price, and they have now leisure to repent of former acts, and to acknowledge with regret that land once cleared of timber does not soon clothe itself with a new growth of merchantable trees; that they can run up piles of brick and mortar, but that they cannot run up trees; that the thing once done cannot be undone, and that there is no species of architecture by which they can erect oaks, beeches, or other stately timber trees at will. For a great many years that noble timber would have afforded a handsome annual revenue, as well as an inexhaustable supply of material for the once-flourishing Colonial dockyards.

"In addition to this wholesale destruction of forests in the North American Colonies, there existed a practice (barbarous, reprehensible, and wasteful) by which the colonist, after procuring two or three successive crops from land newly cleared and burnt, commenced to cut and burn the forests in a new place, changing his location every two or three years.

"The effects of cultivation in the States, as observed by *Mr. Stevenson* in 1840, can now be traced as far as the Alleghany Mountains, the greater part of the land between them and the ocean having been cleared and brought into cultivation. 'It is much to be regretted,' continues *Mr. Stevenson*, 'that the early settlers in clearing this country were not directed by a systematic plan of operations, so as to have left some relics of the natural produce of the soil, which would have sheltered the fields and enlivened the face of the country, while, at the same time, they might by cultivation have been made to serve the more important object of promoting the growth of timber. Large tracts of country, however, which were formerly thickly covered with the finest timber are now almost without a single shrub, everything having fallen before the woodman's axe, and in this indiscriminate massacre there can be no doubt that many millions of trees have been left to rot, or, what is scarcely to be less regretted, have been consumed as firewood.'

"This work of general destruction is still going forward in the Western States, in which cultivation is gradually extending, and the formation of some laws regulating the clearing of land, and enforcing an obligation on every settler to save a quantity of timber which might, perhaps, be made to bear a certain proportion to every acre of land which is cleared, is a subject which I should conceive to be not unworthy of the attention of the American Government, and one which is intimately connected with the future prosperity of the country. But should population and cultivation continue to increase in the same ratio, and the clearing of the land be conducted in the same indiscriminate manner as hitherto, another 100 years may see the United States a treeless country. Can we regard such a prospect as this as the triumph of civilization, and not rather as the result of reckless folly? Even the notice of American novelists has been attracted to this subject, and *Mr. N. Hawthorne* tell us that the New England yeoman is now as niggardly of each stick of firewood as if it were a bar of Californian gold.

"Nor was it to any kind of civilization that the partial destruction of the forests of France can be attributed. The French Revolution broke down the barriers which the authorities had opposed to the destruction of the forests. The mob (out of hatred to the former Government), and the landed proprietors, who had hitherto jealously conserved them, carried fire and destruction into the woods, and the trees disappeared in all directions, and the French Government have long been engaged in endeavouring to repair the ruin effected in those frightful times.

"The destruction of forests is a matter of much more serious anxiety for most governments than for Great Britain, which has the happiness to possess such inexhaustible stores of underground fuel, and many Colonies to send her supplies, consequently the calamity of a scarcity of wood and its bad effects on all the domestic, public, and social concerns of the people visible in many woodless countries are not felt in England, where the destruction of forest has been greatest.

"From the earliest records we possess we learn that every country in Europe, including Iceland (where now there is not a single tree), was thickly covered with forests. These were no doubt swept away by a fast-increasing population, and the necessary clearing in the first step of civilization to provide a corresponding amount of food. Ireland used to be called the woody isle, and the descriptions of *Strabo* and *Ptolemy* corroborate the existence of extensive forests in Scotland, where the Roman legions, by command of the Emperor Severus, were employed in cutting down the forests.

"But we are now on a higher platform of civilisation, and are able to perceive by the help of these ancient records, as well as by the discoveries of recent science, that forests are something more than obstructions to cultivation and storehouses of materials for the arts of civilised life. We now know that a forest is not merely an aggregate of trees, but an embodiment of life, subject to disease, old age, and death, and that in their living functions they influence the physical character of a country, and are connected with important changes in the economical, commercial, and artificial relations of the population; that they enter into mutual relations of cause and effect, with many physical phenomena which affect the productiveness and agricultural intersts of a country. This knowledge has been of slow growth, and has had to combat with much ignorance and prejudiçe, and whatever good ground may have been discovered for despising scientific theories, the facts collected together are too numerous and too authentic not to carry with them the fullest conviction.

"According to the report of *Tacitus*, the sky of England, which was densely overspread with large forests, was constantly overcast with clouds and rain. The cold however, was not very great, and, according to *Cæsar's* statement, the cold was not so intense as in France. *(Vita Agricolæ, cap. XII., and Cæsar, de Bello Gallico, lib. V. cap. X.)*

"In Italy, in ancient times, the forests occupied all the hilly districts, while the water accumulated and spread over the low lands. The history of the earliest period informs us that immense quantities of timber were exported in exchange for wine, oil, and other products. Inundations of the Tiber surrounded the Mons Palatinus with a marsh, and the woody declivities of the Appennines exerted such a powerful influence on the temperature of Italy, that according to *Livy*, the hardy Roman soldiers suffered much at the siege of Viji (404 A.C.) from violent frosts and heavy snowstorms. According to *Columella*, there were in his own lifetime winters so severe that the frost destroyed every tree in the vicinity of Rome; and *Livy* states that ice interrupted the navigation of the Tiber, which was every winter regularly covered with ice; and *Horace* in his Odes states states that the streets of Rome were frozen over, that Mount Socrate was covered with snow, and that ice obstructed the course of rivers.

"All those phenomena have long ceased; even hoar frost appears to be a very rare occurrence. Occasionally we hear of snow showers; but no sooner has it fallen than it melts away; and no sensible alteration is produced on the present high temperature of Italy.

"The prevalence of this latter must be exclusively attributed to the clearing of the forests situated on the slopes of hills and mountains.

"In Spain, according to the report of *Livy* (*lib.* XXI.), the snow of the year 218 A.C. lay in the vicinity of the Ebro for 30 days to the depth of four feet.

"*Tacitus* states *(Germania V.)* that the cold weather prevented fruit from ripening, and even 50 years before Christ grapes failed in Belgium. According to *Ovid* (*Eleg. X.*) the vines were frequently destroyed by frost in countries where nothing similar is now witnessed; even wine froze in open vessels, and the Black Sea was covered with ice so strong that heavy waggons could pass safely over. A temperature so low occurs no longer in these and other countries of the same latitude.

"We draw, therefore, the conclusion that 1,800 years ago extensive forests exerted such a strong influence on the climate that the temperature of the coldest month was from 9° to 11° Faht. lower than at present, and that Germany had winters like those of Western Russia. It follows from observations, calculations, and historical notices, that, in consequence of the clearing of forests, the temperature of European countries has been on the increase; an effect produced entirely by the labours of man.

"Similar and still greater alterations in temperature are linked with those depending on forests, in so far as they are attributable to the formation and preservation of flowing waters, and these as a matter of course possess a powerful influence on the physical condition, the trades and manufactures, the agriculture, commerce, and navigation of a country.

"All the rivers of Europe testify to the retreat of their contents to a lower level, as also to the drying up of innumerable springs. The large masses of water they used to carry formerly excavated the valleys and laid the foundation of the alluvial plains. The drifted silt is found far from their present banks, and leads us to form some estimate of the breadth of their original beds.

"The hands of man, says *Sir Roderick Murchison*, in his 'Geology of Russia,' have produced and are still effecting considerable changes in large tracts in Russia by the destruction of her forests. A few centuries only have elapsed since Northern Russia was a dense virgin forest, with vast intervening marshes and lakes, but now her gigantic pine trees are felled, lakes and marshes drained, and the culture of corn extended to the latitude of the White Sea. The natural recipients of so much moisture having been destroyed, we may thus in a great measure account for the sensible diminution of late years in the waters of the Volga and other great streams whose affluents rise in those very countries. Certain observers have supposed that there is the same volume of water as before, but that it flows off more rapidly. Whether this opinion be adopted, or that of a sensible annual diminution of moisture by the destruction of dense forests which formerly obstructed evaporation, the result is the same as concerning the effects on the surface and internal tracts of the country. 'For our own part,' adds *Sir Roderick*, 'we can scarcely refrain from thinking that the axe of the miner (for wood is the chief fuel of Russian miners) has been a prime cause of this increasing drought, an opinion we formed in the Ural Mountains, whence the greatest feeders of the Volga proceed, and where the inhabitants, complaining of the annual decrease of water, invariably refer this effect to the clearing away of the forest.'

"In another part of the same work *Sir Roderick* states as follows: 'Covered as Russia has been with magnificent forests which have hitherto supplied her inhabitants alike with shelter and with fuel, the time is fast approaching, and in some large tracts has already arrived, when these resources will no longer meet the exigencies of an increasing population.'

"The Island of Mauritius presents, in its central plateau, vast forests remarkable for the multiplicity of species which compose them. The persons employed in the cultivation of the sugar-cane have carried on an incessant war with these forests, and every day has seen their area diminishing. But it appears, from a recent official report to the Royal Society of the Mauritius, that the authorities of the island are now alarmed at the streams, which were once so copious, gradually drying up.

"'At the same time,' says the secretary, 'that the water in the river has diminished, the forests have been thinned to a considerable extent, and we will now put the question, whether the guardian of the woods and forests should not be charged with replanting trees to replace those that have disappeared?' 'Let us cast our eyes,' continues the secretary, 'on the barren and naked mountains which surround the town of Port Louis, and when the sun reflects its burning rays, picture to ourselves the mountains covered with trees spreading shade and coolness.' 'If this island' adds *Professor Lindley*, 'should in time become barren, it will only undergo the fate which universally attends the destruction or absence of forest in countries exposed to great solar heat.

"Travellers in Mauritania have discovered in the plains of Mitidjah, and the province of Oran, traces of a vegetation which is no more, and which has left behind it only the sterility and aridity of a desert. In the province of Constantine, of Philip-ville, on the borders of Rummel, there is not a tree where formerly there was extensive cultivation and a dense population.

"Judæa had also its forests in ancient times, and which are now to be sought for in vain, and we even find the name of perhaps the most ancient conservator of forests in Palestine, ander King Artaxerxes, in the second chapter of Nehemiah. There is frequent mention in the Bible of the 'iarim.' Upon Lebanon were found those famous forests of cedars of which, in the present day, scarcely any remain. Upon Anti-Lebanon pines and firs furnished the Phœnicians with timber for their ships. On the mountains of Bashan there were forests of oaks.

"The Bible furnishes us, too, with the names of several forests, the actual sites of which are now occupied by an arid soil. Such is the forest of Ephraim, that of Kareth, of Korcha, in the tribe of Judah; such was that which covered the district of Baalah on the frontiers of Benjamin and Judah, and to which that town owes its surname of Kirjeathjearim (the town of forests).

"The Phœnicians were the principal agents of destruction for the forests of Palestine and Syria. Before the time of Eratosthenes, Cyprus, since so destitute of wood, was covered with forests, and they were thought such a nuisance that possession of land was given to those willing to clear it of trees.

"'In felling the trees which cover the crowns and slopes of mountains,' says *Humboldt*, 'men in all climates seem to be bringing on future generations two calamities at once, a want of fuel, and a scarcity of water.'

"Returning to America, let us examine a district where the climate is analogous to that of Europe, viz., the table-land of New Granada, which is 10,000 to 14,000 feet above the sea.

"The village of Ubaté is now situated in the neighbourhood of two lakes, which 70 years before formed but one, and the old inhabitants saw the water shrinking year after year. The old sportsmen, as well as the annals of the various parishes, show that extensive forests have been cut down in the surrounding country, and the clearing still continues. The inhabitants of Zimjaca, another village in the same valley as Ubaté, all knew it was built close to another lake, and it is now a league from its bank. Formerly, there was no difficulty in obtaining building-timber, as the mountains which rose from the valley, on either hand, were covered with trees, which have mostly all disappeared by the eagerness to procure fuel in manufacturing salt from the springs of Taosa.

"To these facts, gathered from many sources, and which I could multiply and support by many others of a similar kind, it may be replied that the diminution of the water, incontestable as it is, might have taken place without the clearing away of the forests and might be due to unknown causes; but it would not be difficult to show that lakes in the vicinity of those that have shrunk most remarkably, but around which no destruction of forest has taken place, have undergone no change in level.

"The conclusions which it seems legitimate to draw from the whole of the facts now brought together, are,—

"1st. That the *wanton* destruction of forest has entailed barrenness and aridity on countries renowned in former times for their fertility.

"2nd. That along with woods, springs and rivulets, disappear and cease to water the parched land.

"3rd. That the actual temperature of a country is by the destruction of its forests very sensibly increased.

"4th. That the rain gradually washing away the vegetable earth from the sides of the denuded hills condemns them to sterility, while these latter, no longer able to retain and regulate the flow of water that falls on their slopes, are scored by deep gullies formed by impetuous torrents, while the beds of rivers are at one time dry, and at another filled by sudden and short-lived floods.

"We have still to enquire whether extensive clearings of the forests which embrace a wide district cause any diminution in the quantity of rain that falls.

"Springs and rivulets may shrink and disappear without the effect being ascribable to any decrease in the quantity of rain. Unfortunately, the observations we possess on the quantity of rain which falls in any particular district of sufficient antiquity and accuracy to be worthy of confidence are scarcely to be found out of Europe, and there in the generality of instances the soil was cleared before observation began.

"The United States of America, where the forests are disappearing with such rapidity, will probably one day afford elements for a satisfactory solution of the question.

"It may be argued, not that the annual quantity of rain is lessened, but that what does fall goes further where there are forests; that in attracting and retaining the moisture of the atmosphere, and by presenting an immense warmth-radiating surface, and condensing the vapour, forests are visited with frequent showers; that the thick canopy of verdure prevents the rays of the sun from penetrating to the ground and absorbing its humidity. This is all true, but this would merely prove that forests economize the rain.

"It does not, indeed, seem legitimate to decide that because a country is covered with wood, therefore it is visited with abundant rain. It seems more probable that because the rain is abundant, therefore it is covered with wood.

"We know that rains fall abundantly in several parts of the ocean, where of course there are no forests to account for it; and yet there are very extraordinary phenomena which still remain unexplained and merit the closest investigation of meteorologists. Thus, along the whole coast of Peru there is no rain, and no vegetation throughout a large circuit. The rain commences first in the north of Tumbez, and there extensive woods are seen; towards the east it begins first in the valleys of the Cordilleras, which abound in vegetation.

"The fact is undoubted that there are level countries, particularly under nearly the same latitude, although the one contains a much larger extent of forests than the other, which receive about the same annual quantity of rain.

"Thus, for instance, in the woody plains of Bavaria and Prussia the amount of rain is on the whole scarcely greater than what falls in the plains of Champagne, which are destitute of wood. This throws a new light on the subject, and leads us to inquire whether there is any marked difference in the fall of rain between hills and mountains closed with forests and those entirely denuded.

"We know that the lowest stratum of air contains the greatest quantity of aqueous vapour, and hence it might be expected, *ceteris paribus*, that more rain would fall on low, level plains than in elevated countries. The contrary, however, is the fact. The increase in the amount of rain is gradual as we ascend up to from 1000 to 5000 feet, according to the latitude of the place.

"This may be accounted for satisfactorily by the colder air on elevated places, and by the clouds resting on the summits of mountains without descending into the plains. Hence we may lay it down as a certain fact, both from theory and experiment, that the rains increase with the elevation.

"If mountains be protected from solar radiation by forests, and if the transpiration from an enormous leaf surface has the same cooling effect as terrestrial radiation, it stands to reason that the effect of elevation (*i.e.* the increase of rain) is still further augmented. We are thus lead to the conviction that it is mainly variety of territory, table-lands, and mountains whose slopes and summits are covered with wood, which encourage and keep up the annual amount of rain.

"As a proof of this, we may instance the provinces of Estramadura and Murcia, in Spain, where there are mountains that have been stripped of their forests, and where there is frequently now no fall of rain for eight or ten months, and where the prevalence of dry, sultry weather forbids agriculture, while Catalonia and Valencia are covered with wood, and possess a moist and productive soil. It seems, therefore, unquestionable that the unforesting the slopes and summits of hills and mountains and other elevated lands does actually diminish the mean annual quantity of rain.

"It thus amounts almost to demonstration that the exertions of man in connection with forests have had and always will have a very material effect in altering the physical character of a country; it may be for good, it may be for evil. Germany, once a continuous forest, has been greatly improved in climate; the marshes of Burgundy have been dried up, and rendered fit for the cultivation of the vine; Dauphiné has ceased to be on the borders only of a cultivated country, as it was in the time of the Romans; maize now yields fine crops on the northern side of the Spanish and Italian frontiers, and the chestnut and vine ripen their fruits on the banks of the Rhone and Danube, where once they could not have existed.

"The climate of the United States has become milder since the forests have been destroyed and cleared away; and vegetables transplanted from Europe, which refused to thrive on account of the cold and damp condition of these wooded countries, now easily arrive at a state of perfection. But when we come to consider the effects of such clearings in tropical and subtropical countries, where the blazing sun pours down his ardent rays on the surface of the ground, we come to the darker side of the picture. Thus the fertile plains on the slopes of Mount Atlas, deservedly called the Gardens of the Hesperides, have lost all their fertility with their streams and forests. Thus the Canary Islands, the mountains of Greece, and many countries renowned in ancient history for productiveness and a numerous population, despoiled of their forests, are condemned to the miseries of dearth, drought, and barrenness. The very same causes which have improved the climate of temperate and cold regions render that of the tropics more insufferable.

"There are places in the tropics, however, which would be improved by being drier than they are; such as the marshy forests of Guiana. It is a very general belief that dense forests are the cause of malaria, and it is very natural to think so when we find such places the chief seat of malaria. But the truth is that we know little or nothing of the origin of malaria; we are certain that it cannot be attributed to growing trees, however dense.

"In the present state of our knowledge on this subject, it would not be philosophic to form any decided opinion, though there is some reason to think that stagnant water, whether in a thick forest or in an open country, may be one of the causes of malaria.

"When people talk of telluric influences, they only invent a name to hide their ignorance, and do not come any nearer a solution of the question.

"The practical conclusions we should draw from the above remarks are these, that when it is found necessary to denude a district of trees, either for the sake of agriculture or to destroy its unhealthiness, we should encourage the disforesting of the plains, where water may be stagnant in the soil, and discourage as much as possible the cutting of trees on the slopes of the hills, more particularly if they are steep, for there water cannot rest, and we should not be improving but rather spoiling the climate by the denudation of such places.

"We can make a practical application to this rule with great advantage in North Canara, a country where the forest is out of all proportion to the population, and where it is desirable that every valley among its hills be cleared of timber.

"The Germans boast that they owe the preservation of their forests to their own good old conservative tendencies; that they now build their dwellings, warm their bodies, and cheer their spirits by means of the well-cared-for posterity of those very woods in which their ancestors hunted the elk and urus. But others tell us that Germany has always been overstocked with forest in proportion to the population, and that it was owing to the foresight and good forest regulations of Frederick the Great that their forests have been so well preserved. We learn from the reports of the Paris Exhibition the great value and importance which Austria attaches to her forests, which are there called the sources of the nation's wealth.

"It is on account of fuel, however, and the absence of extensive coal deposits that Germany generally has been forced to pay so much attention to the preservation and management of her forests. This is evinced by the long establishment of numerous forest officers of every grade, and by the issue of many publications for instruction in forest management by men of science.

"'As trees (writes *Dr. Hartig*, a distinguished German author on forestry) are rooted in the soil, so is the welfare of the German people, with its thousand roots, bound up in our German conservative system of forestry.' This would be an extravagant statement in England, but not so in Germany or any other country in which a numerous population is dependent on trees for fuel.*

"* The British carboniferous basins may be estimated to embrace some 5,400 square miles of coal; the French a little less than 1,000, and the Belgian about 510; the Bohemian field some 400, that of Saxony only 30, that of Spain probably 200, and that of all Russia scarcely 100 square miles. Comparing the coal areas with the total surfaces of the respective coal-producing countries, the United States has 1 square mile of coal to each 15 of land; Great Britain 1 to every 22½; Belgium a like proportion, and France but 1 of coal to every 200 of country.

"Although the minute and complicated details of European systems of forest management are not suitable for this country, with its scattered natural forests, yet the general principles on which natural forests in all countries ought to be managed are invariable and at the same time few and simple, and I now proceed to state what these are.

"The first object is not pecuniary advantage in the realising of a revenue, public utility is the thing chiefly to be considered; this principle cannot be contested. There is a permanent necessity for the products of the forests, a demand which, with an increasing population, will never grow less, and the first object should be to have such an extent of forest land under the absolute control of the State as will fulfil this object, that is, that the supply shall be sufficient for all wants.

"The second object is to prevent as much as possible this supply from ever failing at any future time. It must be fostered not only for the present generation, but for posterity. The management should be like that of a charitable institution which can distribute its income without injuring its funds; the sources of that income, as every overstepping of this boundary, is sure to revenge itself sooner or later.

"The present generation is the depository of the interests of futurity, and is entitled only to the usufruct. The governments of the present are the proprietors of forests in a different sense to that in which the word proprietor is generally used, and resemble a person who enjoys a life-interest in a sum of money the capital of which is never to be reduced.

"The lesson taught by a comparison of countries in their ancient and modern condition forces another and important object on our attention, viz., to guard against the denudation of any particular district, so that those salutary effects on the climate and water supplies which have been already so much dwelt upon may continue permanent. These are all the great principles that demand attention; to which may be added another subordinate to the above, which is, that no timber tree should be cut down until it has arrived at maturity, or allowed to remain uncut after it has reached that period.

"A farmer would be considered insane if he cut down his crop before it was ripe, or if he permitted the over-ripe ears to drop their contents on the ground before he gathered in his harvest, and yet this insane practice is carried on every day with regard to trees, thousands of which in India are every year lost to the State and to the public by want of attention to the present rule.

"When a tree ceases to increase in bulk this is a most certain criterion that it has arrived at maturity, and therefore to retain it longer is a loss, for the life of every tree is divided into three periods, which may be compared to infancy, manhood, and old age in animals.

"Practical commentaries on these rules are all that appear to be demanded for the guidance of those to whose control forests are entrusted.

"It would be no easy task to endeavour to calculate the time that the timber supply of the Bombay Presidency will last, if the present rate of demand be taken as a guide; any speculation on such data would be vain, as that demand is increasing at a ratio which for future years it is impossible to calculate.

"When, however, it is taken into consideration at the same time that the principal jungle districts form a narrow line running north and south; that from that line chiefly the inhabitants of the treeless northern and eastern parts of the Presidency, Cutch and Kattywar, must obtain their supplies; that Bombay generally is a comparatively dry country; that our forest trees are consequently much slower in growth than in the more humid parts of the Peninsula; then those who know the country will concede that we have not any unnecessary superfluity, nor any reason for permitting waste, or for neglecting the conservation of any jungle tract.

"Government have already acknowledged the growing scarcity of timber and firewood throughout the Presidency. Such being the case, we must disapprove of any scheme for limiting the extent of forest conservation, for marking off reserves, and leaving the remainder of all forest land beyond the pale of protection. Such a scheme is actually in existence. Fortunately, however, it exists only on paper.

(To be continued.)

ANALYSIS OF CANE SOILS.

The Colonial Company has caused portions of the soil of certain of its estates in the West Indies to be analyzed, with the view of ascertaining the best course of cultivation and the most suitable manure to be applied to each. Analyses of cane soils have frequently been inserted in *The Sugar Cane;* and the importance of obtaining a series of such analyses of soils on which the cane has been cultivated year after year for hundreds of years, to compare with those of virgin soils only just brought under cultivation, can scarcely be over-estimated.

Having been favoured with the reports of the analysts, the one by Mr. Sibson, F.C.S., is now inserted.

REPORT ON SAMPLES OF SOILS, SENT BY MESSRS. THE COLONIAL COMPANY, LIMITED.

Sample marked E.S. also No. 9.

This soil contains good elements of fertility but in an undeveloped state. It is very deficient in lime, the amount of this body present being too small to allow of estimation. As this constituent is an essential element of fertility, its addition in some form is desirable. Would advise the use of the manure described as Manure No. 1 (page 540), also the treatment there suggested for the amelioration of this class of soil.

Sample E.S. No. 8.

A very peaty soil, consisting of nearly three-fourths of vegetable matter in the form of humus, &c. It contains also a good proportion of lime, hence its addition to the above and following samples, if practicable, would be advantageous. If any means exist for drying this soil, either by the waste heat of furnaces, or in the sun, it might possibly be used as fuel: the ash would in this case constitute a valuable addition to nearly all these soils, as it contains a comparatively large proportion of lime, in which they are deficient. As a soil it is deficient in phosphates, and would be benefited by the addition of a good dissolved bone manure.

Samples E.S. No. 10 and E. S. No. 11.

Similar to No. 9 but somewhat more loamy, and the latter with more organic matter. Treatment similar to that for No. 9.

Samples ◇N 23 and ◇N 24.

Both very strong clay soils, with good elements of fertility, but in a dormant state, requiring much mechanical improvement to render these elements available for vegetation. The manure mentioned above would be suitable.

Samples L.E. 5 also 20.
,, L.E. 13 ,, 21.
,, L.E. 38 ,, 22.

These soils have a good composition, although like nearly all the samples here examined are of too retentive a character, but capable of much improvement. Nos. 5 and 38 are the better, having a small though appreciable quantity of lime: No. 13 has no appreciable amount of lime, but a good proportion of phosphoric acid: would advise the application of manure No. 1 to these soils.

EH. Samples 1 also 17.
,, ,, 2 ,, 18.
,, ,, 3 ,, 19.

These soils are somewhat alike and all very strong clays, requiring much cultivation to bring them into a fertile condition. They have good elements of fertility except as regards lime, in which they are all deficient. Would advise the use of manure described at page (540) as No. 2, and all treatment suggested for the amelioration of this kind of soil.

TB. Samples 1 also 12.
,, ,, 2 ,, 13.
,, ,, 3 ,, 14.

These are also very stiff clays, containing much oxide of iron and alumina, and very tenacious. They contain comparatively small quantities of phosphoric acid, and on this account are not likely to attain so high a degree of fertility as some of the foregoing samples in which this item is larger. Would recommend the manure No. 2, and all treatment calculated to lighten the soil.

WV. Samples No. 19 also 25.
,, ,, K. 13 ,, 26.

The first is a good soil containing a fair quantity of organic matter as vegetable remains, and has a high proportion of phosphoric acid, with other elements of fertility, except lime, in which it is deficient. Would advise the manure No. 1.

The second is a much lighter soil than most of the accompanying samples, and might be used to advantage for mixing with the above and others if practicable. I should advise a good dissolved bone manure, or a nitro-phosphate manure for this soil.

BB. Samples 14—16.
,, ,, 16—15.

Both very stiff clays requiring much working to allow of profitable cultivation. Manure No. 2 would be suitable.

Samples PM. 1 also 4.
„ PM. 2 „ 5.
„ PM. 3 „ 6.
„ PM. 4 „ 7.

No. 1 is a good soil, though clayey and very deficient in lime: having no appreciable quantity of this element, its application is advisable, and manure No. 1.

No. 2 is inferior to the above—the percentage of phosphoric acid being small. Similar treatment recommended.

No. 3. A superior soil, having a good proportion of lime, and might be mixed with the above if practicable. It has a slight drawback in the shape of a little protoxide of iron which is sometimes hurtful to vegetation; free working and aeration are the only means of overcoming it. Manure No. 1.

No. 4 similar to 1 and 2, but with slightly more lime.

◇c Sample 1 Surface soil, 12 in. deep—18 in. deep, also 1.
„ „ 2 „ „ — „ „ 2.
„ „ 3 „ „ — „ „ 3.

The surface soil of No. 1 is of fair quality, but capable of much improvement by judicious cultivation. The soil at 12 in. deep has more phosphoric acid than the surface, hence its gradual and cautious admixture would be desirable. The lower layer has less phosphoric acid, and its addition not therefore likely to benefit; would advise use of manure No. 1.—In No. 2 the surface soil has good elements of fertility, but in an undeveloped state, and is much in need of cultivation. The admixture of the lower portions of soil would not be desirable in this case. This soil and also Nos. 1 and 3 are deficient in lime. No. 3 is a good soil, though still susceptible of much improvement. The subsoil, both at 12 in. and 18 in. deep, may be mixed in this case if it be thought desirable to deepen the soil. Manures No. 1 or 2 may be used for these two latter samples.

PP 1 also 27.
„ 2 „ 28.

These are both very tenacious clay soils, and require much mechanical improvement to allow of any manure having a good effect. Are also deficient in lime. Manure No. 2.

La Carriere.

This sample is similar to the above, though not quite so retentive.

These soils being nearly all of a clayey character, the use of ammoniacal manures may be generally indicated as the best mode of bringing their dormant elements of fertility into an active and useful condition. The addition of phosphate also is necessary since, although some of these soils contain comparatively large quantities of this body, only a small proportion of that shown in the analysis is actually available—the remainder being locked up, so to speak, and only accessible as the general character of the soil becomes improved. The other elements, such as potash, magnesia, sulphates, &c., are sufficient in quality. Lime is generally deficient, as pointed out under the respective samples and will be specially noticed presently.

Manure No. 1.

The mixture I have mentioned as No. 1, I would advise to be made of ⅔ superphosphate and ⅓ sulphate of ammonia. Mineral superphosphate (the cheapest form of soluble phosphate) might be used, and a second quality of sulphate of ammonia if preferred in point of price. This mixture should be used in the same manner and quantity as the phospho guano, or other manures now employed for the cultivation of the canes, and I have no doubt its effects will be very marked and superior to other manures. Its cost will also be much less than any of the manures commonly sold for the purpose, and although necessarily considerable, (by reason of the high price of sulphate of ammonia,) will, on soils of the character now reported on, repay a good profit on the outlay.

Manure No. 2.

Is suitable for soils of a heavier character, and on other soils sometimes has a better effect than the above, viz.:—

⅓ Superphosphate as above.
⅓ Sulphate of Ammonia.
⅓ Rape Dust

Rape dust is the residue left from expressing rape oil, when too impure to be used for feeding. This will have the effect of supplying organic matter, which is much needed on some of these soils. This manure to be used in the same manner as the preceding.

(To be continued.)

THE GOVERNOR OF JAMAICA "INTERVIEWED."

Sir J. P. Grant did not (it is said) escape being "interviewed" in his passage through New York recently. A reporter of the *New York World* gives the following account in the *World* of the 2nd of September:—

Reporter: I trust, Governor, you will not find my question an improper one; but the readers of the *World* would be pleased to know whether or not your voyage to England has any bearing on the project of the confederation of the British West Indies, British Honduras, and British Guiana, after the model of the Dominion of Canada? The Governor: I have not the slighest objection to answering the question. My voyage has no bearing that I know of on the projected confederation. In fact, the project is to-day an abandoned one. The difficulties to be surmounted before such a confederation could be formed were found to be too great for the project to be successfully carried through, so it is no longer urged or seriously talked of. In Jamaica it was never extensively advocated, that I am aware of. Reporter: Having completed your European journey, will you return to Jamaica? The Governor: It is the custom of the British Colonial Office to leave a man in an office like the one I hold seven years. I have not as yet completed my sixth year; therefore I expect to return and serve up to

November, 1873, which will terminate my seventh year. Reporter: The true friends of Jamaica here will, I am sure, be happy to learn that you are not to be separated from its governorship, since your administration has been very successful. The Governor: Thank you, sir. It does not become me, of course, to say whether or not my administration has been successful, but this I can nevertheless affirm, that in Jamaica things have truly changed for the better, socially, morally, politically, and materially, since I went there. The people have, I believe, become better, happier, and wealthier. Trade, commerce, manufactures, and agricultural productions have considerably increased, and the Government become a more efficient agent for good. Laws are now better observed and administered, taxes are more easily collected, and the Treasury is no longer on the verge of bankruptcy, but, on the contrary, always abundantly supplied with funds sufficient to meet all demands upon it. The Government's credit is fully restored, and considered good in the best financial 'changes in Europe. The yearly revenues have exceeded the expenses by nearly £60,000, and this has enabled the Government to considerably reduce the taxes, so that the rate of taxation is less to-day than it was under my predecessors, Governors Eyre and Sir Henry Storks. In consequence of this decreased taxation the revenues will naturally be less this year than they were last year and the year preceding; still I am satisfied they will exceed the expenses by a handsome sum. A more efficient and honest collection of the taxes and the increase of the trade, commerce, and productions have been, I am happy to say, the means of bringing on the remarkable financial improvements in the condition of the Treasury under my administration, and not increased taxes and duties.

Reporter: Has Jamaica a Constitution? The Governor: Yes. One promulgated during the short rule of my immediate predecessor, Sir Henry Storks, and popularly known as the New Constitution. By it power is more fully concentrated in the hands of the Executive than it was by the preceding instrument, and to this fact, I think, much of the improvement in the condition of Jamaica is to be attributed. The people under it are led in a great measure to eschew politics and their broils and turmoils, for all of which a vast majority of the Jamaicans are unfit by education, temperament, habits, and opportunities. But though the new Constitution goes this far, bear in mind, it grants equality, social included, to all classes—blacks, mulattoes, and whites equally alike. Reporter: Is there much of an emigration from and immigration to Jamaica? The Governor: The emigration from the island is small, and is more than compensated by immigration. From 1200 to 1500 Cuban refugees have settled there of late years, and are proving a valuable acquisition to the population. Many of them are engaged in the cultivation of tobacco, and doing very well pecuniarily. The tobacco they raise is said to be equal to the best second grade of Cuba tobacco, and makes excellent cigars. Jamaica is also attracting attention as a winter resort for American tourists, and last season was patronised by many of them. During the winter months the climate is delightful, particularly in the hills. I have a residence in these hills, 2700 feet above the level of the sea, and only 11 miles from Kingston, and a more pleasant and healthy place of winter and summer resort I have never seen, not even in Italy.

THE CROPS IN NATAL.

The severity of the present winter—if one can apply such a phrase to a season of such sunny days and bright moonlit skies—ought not to surprise any one who remembers what the conditions of the autumn have been. It is some time since we had such frequent successions of frosty nights, and in ordinary course a bad year may be considered to be due. But the late rains in April and May, left the ground in all lowlying localities saturated with moisture, which the sun's rays have since been ineffectual to dispel. Frost is, perhaps, the most difficult of all visitations to deal with, though drainage, doubtless, helps to diminish the evil. Happily for Natal, its "gentle undulations" reduce the experience of disaster to a minimum. Were our coastlands as flat as those of Demerara, sugar planting would scarcely be possible here; but as they are, most of the plantations are out of the reach of the weather.

It remains to be seen what amount of damage is likely to be suffered from this cause. Until July is fairly out, danger will impend. We are glad to hear that the injury done at the Umlasi and Isipingo is not so serious as might have been feared. Our chief fear is for the young cane to be crushed next year; although the ensuing crop, already injured by drought, could ill afford to bear a further visitation.

The slow pace at which extension is going on in this enterprise, suggests the enquiry why it should be so? On all hands we are told that "sugar is the 'thing.'" Both cotton and coffee culture are at present overshadowed by the superior attractions of the larger enterprise. Good crops and good prices have to do with this accession of confidence in a pursuit that has not always been so remunerative or so popular. But how is it that with such inducements to plant, the area of cane grown advances so slowly? We much doubt whether the next sugar crop will be so large as either of the two last. We scarcely ever hear of a new estate being formed, and the new mills that are erected are put up on old plantations. Several causes lead to this; the chief, perhaps, being the increasing scarcity of land near the port, available and fit for cultivation, and the uncertainty of the labour supply. The former is a matter worth special consideration. It is unfortunate that so much suitable land should be locked up. Between Kafir locations, insolvent estates, and absentee proprietors, there must be a vast acreage lying in a state of compulsory desolation. On the first point we have often spoken out, and the question might well be urged without delay upon the attention of the new Governor. It is preposterous that the progress of the community should be stayed by the existence of such a bar as prevents the spread of cultivation between the Isipingo and Umkomanzi.

It is even more difficult to deal with lands held by insolvent estates and absentees, than with those set aside for location purposes. There is but one way to reach the former classes, namely, the imposition of a land tax. This need not be a confiscatory measure, but it might be so adjusted as to be a stimulant to apathetic or selfish landowners, to take their part in the industrial development of the country. They benefit year by year by the labour and enterprise of other men, but they contribute naught to the common weal.

Railways and labour, however, will do more to extend sugar planting than any law that our legislature might pass, or any taxes it might impose. If transport is abundant and labour is certain, the gains of planting will be such as no holder of suitable land can withstand. Self interest will prompt owners to turn their properties to account.—*Natal Mercury.*

WHAT IS GUANO?

The existence of this marvellous fertilising agent might almost be classed among the wonders of the natural world. The unceasing accumulation of centuries, and nothing less than centuries, could have produced such gigantic results, whether we accept the old and recognised theory that it is the *excreta* of the countless flocks of wild fowl that abound in those latitudes south of the Equator, where these deposits are principally discovered, or turn to the more recent speculations of scientific inquiry. If we accept the former theory, what myriads of ages must have elapsed before deposits one hundred feet in depth could have been formed, when no less an authority than Humboldt has asserted that during the last three hundred years, the deposit on the islands off the coast of Peru has not exceeded a few lines in thickness! And how vast must have been the accumulation we may learn from the fact, that though introduced to the notice of Europe by Humboldt at a comparatively recent date, it was in use among the natives as a fertilising agent under the Incas, and when the Spaniards under Pizarro were carrying their victorious arms into this seat of ancient western civilisation.

The theory that has hitherto been accepted has been, as we all are aware, that it is the excrementitious deposit of the vast flocks of cranes, cormorants, flamingoes and other sea fowl that abound in what we may call the guano regions, Peru, Bolivia, and the Chincha Islands, and this has been thought to be confirmed by the fact that the skeletons of these birds are discovered in such quantities, embedded in the guano.

Accepting this theory, it has been further pointed out, that nature has provided against loss of quantity or deterioration in quality from the inclemency of climate. "A single year of English weather," observes Professor Johnson, "would cause many of the largest accumulations to disappear." But the guano regions are not only almost entirely rainless, but free from heavy dew. The "excreta" theory has however been again called into question, and it is to this that we desire to call attention in this paper. Professor Edwards some time ago questioned the fact, and his observations have been strengthened by the more recent researches of Dr. Habel. We have not enjoyed the privilege of reading the doctor's remarks *in extenso*, but we gather sufficient to warrant the conclusion that the theory is plausible, and if confirmed by the results of further investigation, is calculated to furnish another wonderful instance of the workings of nature's great laboratory. The guano submitted to examination seems to have been from the Chincha Islands, and the results of the chemical and microscopic investigation of these portions which have been found to be insoluble in acids, reveal the fact that they consist of the skeleton remains not only of ancient marine animals, but of animals still existing in the neighbouring sea. The interesting fact has also been brought to light, that there is evidently a deposit of guano at the bottom of the sea, as vessels riding at anchor around the Chincha Islands, frequently bring it up with their anchors. There being, as we have already stated, no rain to cause a "wash" of the soil into the sea, it only occurs to us in the light of a conjecture whether this deposit may arise from the great quantities that are lost overboard during the operation of shipping. Dr. Habel's theory would of course tend to the belief that this is a natural deposit, as he traces the existence and formation of guano as we have said, not to the excrementitious deposits of sea fowl, but to the action of heat combined with some natural chemical agency which is continually at work, converting these animal remains into this most wonderful of all fertilising agents. If the doctor's theory be confirmed by further investigation, he will have had the honour of having brought to light one of the most interesting and wonderful examples of the mysteries of the physical world, that have been made during the present century.

H. B. A.—*Barbados Globe.*

Manure and Manuring.—The great lesson taught us for the first time by Baron Liebig is this: That there are certain indispensable elements of plant food contained naturally in most sorts, viz., potash, phosphate of lime, magnesia, &c., that cannot be sent to the air by burning, nor yet obtained from the air, and therefore if we send them away in the produce which we sell, and omit to bring them back again, the purse will soon be empty. He also tells us that a great portion of these elements, although in the soil, are raw and uncooked, and therefore the plants cannot eat them until they are prepared, or cooked, by cultivation, by aeration, or by the action of certain chemical substances. He also tells us why farmyard manure, when made by cake and corn-fed animals, is not only good to produce all crops, but acts favourably by preparing and rendering available the uncooked plant food, not only in the soil but also in the subsoil, if we could be induced to mix the latter with the manure—which very few will do—because they don't know that they cannot manure the subsoil through the top soil, for the latter holds it fast, and will not part with it except to plant roots. We have plenty of evidence of this fact in the railway cuttings, where we see that the poor subsoil, under the few inches of topsoil, has not even been coloured by manure. We occasionally hear of the danger of over-manuring; but this I can say for a certainty, that we can never over-manure the subsoil from the depth of 1 ft. to 3 ft. Thus, we should not only double or triple our mangel and root crops (for seventy to a hundred tons may be grown per acre), but the withdrawal of such heavy crops would still leave the land capable of producing abundant corn crops; but, as we cannot manure the bottom soil through the top soil, the latter must be thrown or ploughed back, and the manure incorporated directly with the subsoil. Steam-power will very readily give us access to the subsoil by deep furrows. Strong deep-rooted crops, fruit trees, &c., feed in the subsoil. If that is well filled either with solid or liquid manure (but not through the top soil), such plants flourish amazingly. For my shrubs or camellias I bore holes a yard deep, and pour down them guano and water or liquid manure, and they prosper accordingly.—*Mr. Mechi.*

Novel Method of Utilising Waste Heat.—A discovery has been made and applied in Boston, which, it is claimed, will reduce the cost of steam power more than 60 per cent. It consists of a novel process, by which the great amount of heat which escapes into the air in the waste or exhaust steam from engines is utilised, by conducting it through the tubes of a boiler filled with the bisulphide of carbon, a fluid which boils at 110 degrees Faht., and at the temperature of exhaust steam gives a pressure of 65lb. to the inch in the boiler; the vapour formed in this boiler is used to drive an engine, instead of steam, and after being used is condensed by cooling, pumped into the boiler again, and used continuously, without loss. It is claimed that experiments prove that by this process the same fuel now required to produce 100-horse power with the best engines in use, will produce 250-horse power, showing a gain of 150 per cent. in the amount of power obtained by the consumption of fuel.—*New York Daily Bulletin.*

We regret to learn that a telegram has been received announcing the death, from yellow fever, at St. Thomas, of Mr. W. Langford Brooke, of Mere Hall, Cheshire, the owner of sugar estates in Antigua.

Correspondence.

THE DOUBLE EFFECT AND CONCRETOR.

To the Editor of "The Sugar Cane."

Sir,

From the occasional allusions in your paper to the Concretor, and from the frequency with which sales of concrete are announced, it is evident that the use of this apparatus is steadily increasing *for the purpose of making concrete.*

It does not appear however that sufficient attention is directed to the use of this invention as a simple concentrator auxiliary to the vacuum pan. There are certain places where, for various reasons, concrete will not be made, and sugar will be produced, purged in cones, as is the practise in Cuba, or boiled to crystals in the vacuum pan and drained in centrifugal machines.

No reflecting person who has had occasion to prepare the syrup for the vacuum pan in the old battery can have failed to note the mischief occasioned to the colour of the juice, to say nothing of the injury to its quality by the long continued severe heat to which it must be exposed. Few of your readers may be acquainted with the working of the *double* or *triple effet*, which certainly is a great improvement on the open train, but the cost of the apparatus and the maintenance of vacuum by means of a steam engine and air pump, and the supply of water for injection are impediments which have justly rendered British colonists slow to adopt this ingenious but complicated system. Among the machinery of the Rhoda Sugar Factory of His Highness the Viceroy of Egypt, I have the charge of the double effect apparatus and also of a couple of Concretors of the largest size, and after seeing them work side by side for three years, I do not hesitate to draw the attention of your readers to the points of difference :—

1.—The Concretors are easily managed, and are solely under the immediate charge of Arab workmen. They are not liable to get out of repair and we have no difficulty with them. Ever since their erection we have not had occasion to purchase from the makers any extras, nor to send anything to them for repair or renewal.

2.—The fuel used is megass.

3.—The amount of juice concentrated by them is very great, and without these Concretors the double effect apparatus would not be able to turn out the amount of sugar we produce. The syrup from the Concretor is *better in colour than that from the double effect.* This arises from the very short time it is under treatment, and though we have no means of analysis at Rhoda, I think it likely that its quality will also be better on account of its escaping the long time of boiling in the double effect.

After many years' experience of sugar machinery and of sugar manufacture and careful study of the different methods, I arrive at the conclusion that at the present time no concentrating apparatus has proved so valuable as the Concretor.

I am, Sir, yours truly,
William Mein,
Chief Engineer of the Viceroy's Sugar Factory at Rhoda, Egypt.

THE NEW SACCHAROMETER.

Trinity College, Dublin,
September 14th, 1872.

To the Editor of "The Sugar Cane."

Sir,

Will you permit me to make some remarks upon an article in the September number of "*The Sugar Cane,*" in which you speak of an instrument recently brought out by M. Duboscq? I quote from p. 484:—

> "M. Duboscq has lately brought out what is called a new saccharometer, the difference between which and the ordinary instrument is chiefly that the disc, which in the latter is coloured, in the new instrument presents when at the point of polarization two shadows of equal size and density. The idea on which the latter is based, originated with Mr. Jellett, of Dublin."

The natural inference from this statement would be that "the idea" continued to be merely an *idea* till realized by M. Duboscq. The fact is, however, that an analyzing prism constructed on this idea was made under my directions by Mr. Bryson, of Edinburgh, in the year 1860, and was described by me to the Royal Irish Academy, and subsequently to the British Association, in the same year. This prism was used in the construction of a saccharometer, which was exhibited and described by me before the Royal Irish Academy, in the year 1863. A full description of this instrument will be found in the elaborate treatise on "Wines," by Messrs. Thudichum and Dupré (pp. 240-7), for whom it was manufactured by Messrs. Spencer and Son, of Dublin.

I may mention that the idea of using a *Nicol's* prism for this purpose was never published, but *was* contained in a letter addressed by me to M. Soleil, about 13 years ago. If I recollect rightly, the reply to this letter came from M. Duboscq himself. I think therefore that there must be some mistake in the statement that his information came from M. Cornu.

I am, Sir,
Your obedient servant,
JOHN H. JELLETT.

Considering that Professor Jellett had scarcely received justice as to his share in the invention of the new polariscope, we inserted a paragraph to that effect in the last number of *The Sugar Cane* (page 495). We have however pleasure in giving place to the above letter from Professor Jellett himself on the subject.—*Ed. S. C.*

Terrible Hurricane in the West Indies.—A hurricane passed over the West Indies on September 10th and 11th. Many lives and vessels were lost. At Martinique alone about 20 vessels were wrecked. Further details of the West Indian hurricane show that at Guadeloupe three sailing vessels and one steamer were driven ashore; at Dominica every vessel in port was destroyed. The wharves in many places were also destroyed. The wrecks elsewhere were exceedingly numerous.

NEW PATENTS.

2644. J. Harvey, Hillside Estate, Vere, Jamaica, and 47, Lime, Middlesex. *Improvements in the Manufacture of Sugar and in Apparatus therefor.*

790. R. A. Robertson, Clyde Wharf, Victoria Docks, Essex. *Evaporating Liquids and Apparatus to be employed therein.* Dated March 15, 1872.

An improved method of producing evaporation in vacuum pans, or vessels for evaporating liquids, and especially applicable to the evaporation of cane juice, and other saccharine liquids. Siemens' steam jet exhauster is substituted for the air pumps, or other exhausting apparatus usually employed in connection with vacuum evaporating pans or vessels. Other exhausting apparatus, the action of which depends upon the induction action upon air or vapour of a jet, or jets of steam may be used. It is proposed to connect the steam exhauster or ejector, whether of the Siemens' construction or otherwise, to the vacuum evaporating vessel in such a manner as that the steam, air, and vapour, which are exhausted from the evaporating vessel, shall, after mixing with the exhausting steam jet or jets of the exhauster pass along with such steam through heating coils or tubes situate in the lower part of the evaporating vessel, to which the exhauster is applied, or shall pass through the heating coils or tubes of one or more of a series of evaporating vessels, so that the heat of the combined stream of steam, hot air, and vapour shall be utilised in effecting the process of evaporation. It is proposed in some cases to combine a condenser with the evaporating vessel and steam jet exhauster, or ejector, in such a manner that the steam or vapour from the evaporating vessel shall pass into it and be either wholly or partially condensed before reaching the steam jet exhauster or ejector, leaving the air and any remaining vapour only to be acted upon by the exhauster, the heat of the combined stream of steam, air, and vapour being utilised as before described for boiling or evaporating.

MAURITIUS.

(From Licht's Monthly Circular.)

Exports from 1st August to 25th July.

	1871-72. Tons.		1870-71. Tons.		1869-70. Tons.
To England..........	46,730	..	21,608	..	39,504
,, France	13,886	..	6,379	..	11,155
,, Australia	28,548	..	38,316	..	45,879
,, Bombay..........	23,965	..	16,795	..	29,408
,, New Zealand......	3,207	..	3,302	..	3,410
,, Cape of Good Hope..	1,064	..	1,910	..	2,375
,, Other Ports	6,092	..	857	..	1,515
Total..........	123,492		89,167		133,246

HAVANA AND MATANZAS.

Exports from the 1st of January to the 3rd of August.

	1872. Tons.		1871. Tons.		1870. Tons.
To United States of N. America ..	162,831	..	139,126	..	141,120
,, Great Britain	128,083	..	60,082	..	161,941
,, France	18,830	..	10,708	..	43,960
,, Spain.....................	32,637	..	39,416	..	52,576
,, Northern Europe............	11,543	..	7,880	..	9,109
,, Southern Europe............	960	..	548	..	3,410
,, Other Countries	4,471	..	2,851	..	7,509
Total......	359,625		260,611		426,625
Stocks in Havana and Matanzas ..	84,924	..	82,632	..	72,252

STOCKS OF SUGAR IN THE CHIEF MARKETS OF THE WORLD ON THE 1ST AUGUST FOR THREE YEARS, IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	1872.	1871.	1870.
Great Britain	124	171	180
France	39	50	56
Germany (Zollverein)	3	4	4
Holland	36	41	50
Six other Ports	5	5	6
Total in Europe	207	271	296
United States	139	138	146
Havana and Matanzas	85	83	72
TOTAL	431	492	514

CONSUMPTION OF SUGAR IN EUROPE AND THE UNITED STATES, FOR THREE YEARS ENDING 31ST JULY, IN THOUSANDS OF TONS.

	1872.	1871.	1870.
Great Britain	689	705	663
France	273	263	313
Germany (Zollverein)	201	220	209
Holland	23	26	31
Six other Countries	89	113	111
Total in Europe	1,275	1,328	1,327
United States	562	499	467
TOTAL	1,837	1,827	1,794

ESTIMATE OF THE NEXT SEASON'S BEET SUGAR CROP ON THE CONTINENT OF EUROPE, COMPARED WITH THE TWO PREVIOUS SEASONS.

(From Licht's Monthly Circular.)

	1872-73. Tons.	1871-72. Tons.	1870-71. Tons.
France	350,000	327,000	289,084
Germany (Zollverein)	240,000	187,500	262,986
Austro-Hungary	170,000	162,500	182,280
Russia and Poland	135,000	90,000	135,000
Belgium	80,000	73,000	55,739
Holland and other countries	35,000	25,000	17,500
Total	1,010,000	865,000	942,589

SUGAR STATISTICS—GREAT BRITAIN.

To 21st September, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	36	3	4	32	75	65	74	11	13	55	153	182	51	8	10	29	98	143
British East India	7	1	..	..	8	5	13	5	..	..	18	7	8	7	..	..	16	19
Mauritius	3	2	..	..	5	3	13	5	12	7	38	14	12	4	14	10	39	14
Cuba	6	4	3	30	43	25	6	13	21	64	104	51	4	10	17	39	71	39
Porto Rico, &c. ..	3	7	1	3	14	6	5	16	1	7	29	23	2	12	..	5	19	23
Manilla & Java ..	10	3	..	4	17	26	19	10	2	12	43	36	22	16	2	8	48	50
Brazil	3	16	..	5	24	20	8	43	9	20	80	51	5	35	9	20	70	46
Beetroot, &c.	1	..	..	..	1	4	15	8	4	32	59	109	19	10	6	36	71	117
Total, 1872 ..	69	36	8	74	187	155	153	112	61	198	523	473	123	102	58	148	432	452
Total, 1871 ..	73	31	7	44	32 increase		160	91	48	173	50 increase		156	93	46	157	20 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

Notwithstanding the continued increase in stocks, the market has more than once during the month been decidedly firmer and, at one time, a slight advance appeared to have been established; but refiners, who have been heavy buyers, having supplied their immediate wants, the market closes quietly. Reports of an unfavourable character as to the continental beet root crop have been rife during the last few weeks, especially from Germany, and M. Licht's estimate of the crop for the ensuing season has been reduced, but these have not affected the market in this country, in the face of a prospect of fair supplies from the chief cane growing countries.

Stocks in the Four Ports have steadily increased during the past month, though not to such an extent as during the previous one; they are now 32,000 tons above those of last year. Deliveries of raw sugar have continued to decrease, showing a falling off of 20,000 tons as compared with this date in 1871. Imports have now reached an excess of 50,000 tons over those of last year, and of 12,000 tons over those of 1870 to the same period.

No. 12 Havana afloat is quoted at 28s. to 28s. 6d. per cwt., the same figure as at the end of September, 1871, and a little higher than at that date in 1870; Cuba Muscovado is 25s. 6d. to 26s., and shows the same relative value compared with previous years. Middling to good brown Bahias and Pernambucos rule at from 21s. to 23s. per cwt. in bond, an average of 1s. per cwt. lower than last year. The average duty paid price of refining qualities of British West India has declined 1s. 6d. per cwt. during the month, part of this it has, however, recovered; it is now quoted at 29s. per cwt. The price of common refined Lump in London is 39s. 6d. to 40s., being 6d. to 1s. per cwt. above last year's prices.

It is too early to speak decisively as to the results of the beet-root season, which has just opened; but notwithstanding the reports of failing crops from some parts, and poor yield from others, there appears to be every probability that the total continental production will be above a million of tons; and it must be remembered that there is no appearance of increased consumption in Europe, so that the whole of the increased produce will be available for export chiefly to this country.

THE

SUGAR CANE.

No. 40. NOVEMBER 1, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

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SUBSTANCE OF THE REPORT OF THE COMMISSIONERS FROM ANTIGUA

Appointed to enquire into the working of the Central Sugar Factories System in Martinique and Guadeloupe.

(Continued from page 524.)

"District of Lamentin."—This is a fine alluvial valley, surrounded by mountains of trap and conglomerate, which are covered to their summits with dense forests (an ordinance of the Government forbids the felling of these). As a natural consequence it is abundantly supplied with running water. The soil resulting from the disintegration of the volcanic rocks is a stiff red clay, resembling closely that seen in Antigua in the valley between Drews Hill and Green Castle. All the old sugar mills are worked by water power. The canes in this valley are of a rank luxuriant growth, and the the juice is of a low specific gravity, averaging about 9° Baumé. In the private works in this district it is calculated that one ton of sugar costs in expense of cultivation £10.

1 ton sugar, expenses of cultivation	£10
For general expenses	4
	£14

The quality of sugar made sells at £22 per ton. Each ton of sugar gives 50 gals. molasses, which made into rum is worth £2.

Produce	£24
Deduct expenses........................	14
Leaving a profit of	£10 per ton.

Two factories are established in this district, viz., Larcinty and Soudan. Larcinty is one of the oldest factories in Martinique, having been working for ten years. It gives only 5 per cent. for its canes. Its contracts with the planters are about to expire, and it is improbable that they will renew them upon the same conditions, as they generally complain of the percentage being too low. Their properties, however, are in good cultivation, and they are free from debt. An estate in the neighbourhood was shown us from which the proprietor (now resident) in former times had much difficulty in obtaining a revenue of £400, and which is now leased by the usine at £1,000, and it is probable that this sum will be doubled at the expiration of the lease.

"Soudan," situated three miles from Larcinty, is not yet completed; it is entirely built of iron of great strength, with latest improvements, and has a fine railway. It is established on the 6 per cent. principle, and has numerous adherents. All around these factories the evidence of progress and improvement are palpable, the lower slopes of the hills being cleared and planted on every side.

"Usine Robert."—We had not time to visit this factory, situated on the other side of the island, but in an interview with its director we learned the following facts. It is calculated to make 2,000 tons, and the cost of plant was £60,000.

The percentage of sugar was	6½ to	7 per cent.
,, ,, of juice ,,	68 ,,	72 per cent.
In 1871 quantity of canes ground,		22,300 tons.
In 1872 ,, ,, ,,		19,500

The quantity of sugar made was nevertheless the same, so that in 1871 the percentage extracted was 6.29; in 1872, 7.09, the total quantity of sugar made being 1,400 tons. Coals used, including steam tugs, 1,117 tons. The cinders and residue of press are given to planters. The average of rum obtained from molasses is 70 per cent.

GENERAL REMARKS—CULTIVATION.

The tillage and preparation of the land in the French islands are not so complete as in Antigua, and weeding of the canes is not regarded as of such vital importance as in this island. A common double mould board plough (French), with 6 or 8 bulls, opens the land in furrows. Without in general further preparation the cane plants, from 8 to 10 inches long, are inserted in either side of the furrow. We did, however, observe the use of the cross plough upon several plantations.

STOCK.

The commissioners were much impressed with the condition of the stock, in Martinique especially, and the evident care taken of the animals. Magnificent bulls of the Spanish and Senegal breed, of large size, and teeming with condition and strength, grace the meadows waving with nutritious and luxuriant grasses. The plough and draft cattle are stall fed and penned up at night under cover, and the manure is carefully collected, the pens being heavily furnished with the abundant trash from the fields. "The Spanish yoke," or "draft by the horns," the yoke being supported upon the nape of the animal's neck, is almost universal. The weight and physical strength of the animals nurtured upon the fat French pasturages fits them for such an application of draft power. In a desiccated island like Antigua, generally devoid of rich well-watered paddocks and grazing land, and supporting only animals of inferior size, this asserted economy of draft force appears impracticable.

LABOUR.

Ordinary labourers are paid 10d. per day and 1s. at night. We were informed at D'Arboussier that there was some difficulty at first in getting the native labourers to work at night, and coolies were specially imported for this purpose.

INVESTMENT.

As affording the means of investment, usines, both in Guadeloupe and Martinique, are in the highest popular favour. Capital, both local and in France, is freely subscribed to establish new factories upon a large and extensive scale. No less than eight factories, erected at considerable cost, have cropped up within the last two years, and two more large factories are now being erected. This is surely strong presumptive evidence that usines return a very handsome profit. We are able to endorse Mr. Russell's remarks, "that in passing through the country, the difference between the tillage of those selling their canes and those manufacturing at home is most marked. In the one case, the canes are no sooner out of the fields than the gangs and stock are at work, preparing the land for the next crop, and all the fields tidy and clean. In the other case fields are left to take care of themselves until crop season is over."

In most usines, hydraulic or other presses are employed for extracting the remnants of juice from the skimmings. The former are carefully returned to the clarifiers, the residuum being a hard cake, which is used for fodder and manure.

CLARIFICATION OF JUICE.

This is mainly effected with common lime only, the use of the bi-sulphite of lime being rare.

USE OF CHARCOAL.

The filters are filled with animal charcoal, which is covered with the best and softest fresh water procurable.

Syrup is first passed through them for twenty-four hours; afterwards the juice from the clarifiers is sent through them for a like period.

The effete charcoal is revivified by washing in pure fresh water, and subsequent reburning in furnaces especially constructed for that purpose.

The absolute loss of charcoal is estimated from 12 to 14 lbs. per ton of sugar. The cost of charcoal per ton of sugar, including cost of labour engaged in washing and other work, and expenses for passing juice and syrup through the charcoal and other contingencies, is about sixpence per cwt.

The use of bi-sulphite of lime is estimated in Demerara to cost about the same sum per cwt.

An almost inexhaustible supply of pure fresh water is indispensable for washing the charcoal; water charged with earthy or saline matter will not suit, as the absorption of these by the charcoal is not rectified by the revivification process.

RUM AND STILLS.

We were much struck with the distillery process and apparatus and the superior quality of the rum manufactured at the usine. The stills are worked by steam, with continuous action, and a very pure spirit, (proof strength), without any flavour of acetic ether is obtained, more resembling common *eau-de-vie* than rum in appearance and flavour. The average return, we were informed, was one puncheon per ton of sugar.

ADVANCES.

Most usines, we were informed, both in Guadeloupe and Martinique, make advances to their contributory estates to assist in the clearance and opening up of waste land, as well as for the purchase of manures and stock. These advances are deducted from the next crop, and are made with a liberal hand—for instance, the advances made this year by the Usine D'Arboussier amounted to £60,000. These advances, without doubt, have led to the great increase of cane cultivation in these islands, and reaches of country, uncultivated for years, have become weighted with sugar canes. The advantage to all classes is manifest; villagers and others residing close to estates under contract to a central factory, with spare lands now in waste, would be induced to grow canes upon these islands for their mutual benefit, upon terms which the interest of the proprietor would make easy for the cultivator.

We beg to refer to an article in No. 24 of the *Sugar Cane*, and dated 1st July, 1871, page 376, and continued in No. 25, page 393, headed "French Central Factories," which gives an interesting historique (taken from the *Journal des Fabricants de Sucre*) of these establishments. As is forcibly pointed out by the writer, the first experiment made upon a large scale during a series of years, and accompanied by mischances and exceptional social conditions, has fully proved the soundness of the principle of separating agriculture from manufacture. What the isolated planter, bare of resources, was unable to do, the association of capital and the concentration of labour has fully realized, without injury to the chief functions of the planter, which, on the contrary, have been greatly facilitated.

We were abundantly satisfied, and in fact it was proved to demonstration, that such a separation of the two conflicting interests of agriculture and manufacture has been a relief to the planter, and has converted him from the stagnation of despair and apathy to a life of energy and prosperity. It has been stated that the central factory system must ultimately conduce to the exhaustion of the soil on those estates supplying canes to the usines; that whereas in the ordinary system of manufacture, little, if any, of the mineral elements of the cane are finally abstracted from the soil, these being restored in the form of megass ash, distillery refuse, &c., in that of central factories they are absolutely lost.

This, it was admitted, was true; but it has been provided against by the increased employment of chemical manures, these being composed so as to return to the land the principal mineral matters of which the cane has been, by analysis of its ash, found to deprive it. The most successful of these manures was generally considered to be that recommended by M. Georges Ville, an eminent French chemist, and formerly director of the experimental farm of the Emperor. The preface to the last edition of his work, entitled "Les Engrais Chimiques" (Paris, 1872), gives the formula of a manure recommended for the sugar cane. It consists of the following ingredients in definite quantities:—

Superphosphate of lime, chloride of potassium, sulphate of ammonia, and sulphate of lime.

D'Arboussier imports this manure and advances it to its adherents, enjoining its liberal application. A member of the committee on a former visit was shown a field of fifth ratoons, which by its use was yielding two hogsheads per acre.

PROCESS OF MANUFACTURE IN DEMERARA.

The committee during their enforced stay here employed their time in inspecting the principal sugar works in the vicinity of

George Town. The process employed in all these works is the following:—

The canes are brought to the main line of tramway by the planter. The factory takes them to the mill, where the wagon is tilted up by a similar method to that employed in the French usines. The megass is elevated, and is put by boxes running up on an elevated railway into "logies," or the yard to dry. The juice flows from the mill through the strainers into a pump, being treated with bi-sulphite of lime *in transitu.* The pump raises it to the clarifiers, where it is cracked, racked, and treated with lime. From this it flows on to the copper wall, where it is cleaned thoroughly, and is raised by a *montjus* into subsiders, where it is allowed to rest nine or ten hours. From these vessels the vacuum pan draws the juice and boils it to sugar. The first quality is crystallised and cured as soon as possible. The molasses, when good, is worked into the syrup of the following day, until it gets so thick as to darken the first quality; it is then boiled alone, and forms the second quality sugar, being allowed several days to granulate in the coolers, the skimmings from clarifiers and copper wall, the subsidings from syrup boxes, and the molasses from second quality sugar going to make rum.

It will be seen that the essential difference between this and the French process is the entire elimination of the charcoal filters and *triple effet*, and with them the necessity of a large supply of pure water, a matter of much importance where this cannot easily be procured. This process is certainly simpler and less expensive, but whether it extracts the same amount of sugar from the juice may be doubted. We were unable to procure any possible data on this point. The charcoal filter separates from the juice not only the fœcal matter, but also the soluble salts contained in it.

The presence of these (principally salts of soda and potash) is known to have the effect of preventing a certain amount of sugar from crystallising. Experiments were instituted this year to decide this point in two of the principal factories of Martinique during the last fortnight of their working, but the results have not yet been published.

In conclusion, we cannot too strongly recommend the establishment in this island of a central factory, calculated to make from 1,500 to 2,000 tons of sugar annually. The absence of an indispensable supply of fresh or soft water, not to speak of the cost, renders, in our opinion, the French usine system impracticable here. We must discard the *triple effet*, and filtration by charcoal. But it appears to us that the Demerara system would be admirably adapted to our requirements, while the cost is comparatively moderate. It must be remembered, too, that the quality of sugar made in Demerara is better suited to our markets and commands higher prices than the French usine sugar.

The following list of the usines last established in Martinique and actually at work, giving 6 per cent. for their canes, may be found interesting:—

Dillon	1871
Marivi	,,
Riviere Salee	,,
Trinte	,,
Sainte Marie	1872
Soudan	,,
Riviere Blanche	,,

These usines have all contracted to pay 6 per cent. for their canes, and from all we could learn no proprietor would now be willing to enter into fresh contracts at a less rate, while the general confidence in the power of the usines to pay 6 per cent. is shown by the ready manner in which their shares are placed. In a newspaper called *Les Antilles*, dated 6th July, 1872, several of these usines had advertised a dividend of 8 per cent. for the first six months of the year, it being understood that a further and larger dividend is always declared at the end of the year.

LOCAL MARKET.

The planter can readily dispose of his produce, as soon as it is fit for market, upon the spot, both in Guadeloupe and Martinique. Daily sales take place at a fixed hour in the forenoon upon the wharfs, and the competition amongst speculators for shipment is very keen, the telegraph being freely resorted to to govern operations. The planter sends his produce to the selling place. Here at the time of auction sample casks are opened at both ends, so as to show the footings as well as the head sugars, and an average estimate is then made by the purchaser of the quality of the entire cask, and this estimate governs the price offered.

The great advantage in every respect to the planter of a ready and immediate sale for his produce for cash upon the spot is too obvious to need comment. Rum is readily sold, and in any quantity. The consumption in France and the French colonies being very large, all molasses not turned into sugar is converted into rum.

THE LIVRET SYSTEM.

Vagrancy in the French islands is effectively repressed by the system known as the livret system. The police are empowered to arrest any one who cannot give a satisfactory account of his or her employment or means of living. Amongst the peasantry, it is the practice to obtain a certificate or livret from their employers, which shows their engagements. Any person found wandering about without a livret, and who cannot explain satisfactorily the reason why he is out of employment, is liable to be punished by imprisonment as a vagabond. This system works very successfully, and compels the labouring portion of the people to industrial habits. So far as we could learn, there was little or no "squatting" in the French islands, though there are extensive ranges of uncultivated mountain and dell.

PARA-GRASS.

This is a vine grass, which is said to be indigenous in Guadeloupe and Martinique; it grows in profusion in the fields, and is a most succulent fodder for cattle. We were told that it was a very useful agent in keeping down obnoxious grasses, while it does itself but little permanent injury to the young canes, and is easily removed, when required, from the land. We observed fields of young canes that appeared to be choked with the rank luxuriance of the para-grass, but we were assured by more than one planter that this was not the case, and it appeared to be the custom to let it grow among the canes until they were three or four months old.

From all we could learn, its introduction into this island would be very beneficial.

Before leaving either island, we submitted a series of carefully prepared questions in writing upon general subjects connected with central factories to disinterested persons, who promised to procure for us replies from reliable sources. We much regret that these have not yet been received, the explanation offered being that time had not sufficed to procure them.

ANALYSIS OF CANE SOILS.

REPORT ON SAMPLES OF SOILS, SENT BY MESSRS. THE COLONIAL COMPANY, LIMITED.

By Alfred Sibson, F.C.S.

(Continued from page 541.)

The great defects in these soils generally is a too adhesive character consequent on a superabundance of clay, and a deficiency of lime. The proportion of this body in the best of these soils is lower than should be present in a really fertile soil, while in the majority it is unusually low, and in many cases so little as to be inappreciable to the most delicate chemical balance. Its addition in all these cases would therefore be desirable, and this may be done by the use of any kind of calcareous material most readily obtained, such as shell sand, limestone rock, coral rock, marl, &c., all of which contain lime in the form of carbonate. These materials would also have a further beneficial effect in adding to the porosity of these soils, sand especially, freely applied, being likely to exercise a marked influence as a mechanical manure; also ashes of any kind.

If none of the above calcareous materials can be advantageously obtained, the use of real or caustic lime (as used for building purposes,) may be advised. This should be placed on the land in heaps and allowed to slake spontaneously, that is, become hydrated by absorbing water from the air by which it falls into fine powder, in which condition it can be evenly distributed over the land. In using lime in this manner, one precaution must be specially observed, viz., to allow a sufficient time to elapse between its application and that of any ammoniacal manures, such as above advised: since, if this be neglected, much of the ammonia may be lost, lime having the property of decomposing all salts of ammonia: at least six months interval should be allowed. In using lime in this manner, I should advise its application in a few experimental plots before going to any great expense in importing it largely. I may add that the sample of peaty soil A. No. 8, if procurable in quantity, is well suited to be used as a source of lime, either in its natural state, or if burned; in the former condition its organic matter would also materially benefit many of these soils in which this constituent is wanting.

As regards the adhesive character of these soils, any treatment which tends to reduce this property may be employed with advantage, as above mentioned, and as about to be suggested.

For the want of porosity and friability in these soils, the air and moisture is prevented from circulating through them, and hence the natural processes of preparing the elements of fertility for the food of plants, which are dependent on this action are but feebly exercised.

For improvement in this particular, I think the use of burnt clay worthy of trial. It should be burnt at a low temperature, in heaps, in the manner adopted for burning "ballast" for railways, or by means of small coal, or "breeze," as it is termed. Any kind of vegetable refuse, however, would answer the purpose if procurable in quantity. The clay thus burned has lost its plasticity, or no longer becomes tenacious by water, and is thus well adapted for admixture with the natural soil for the above purpose, while at the same time it acts as a gentle manure, the processes of decomposition of its dormant constituents having been accelerated by the fire.

It might also, perhaps, be worth a trial to apply the crushed cane, cut in short lengths, to the land with the above object. I make this suggestion in view of the fact that one of the chief points of value in farmyard dung for clay land is the mechanical effect of the straw, which is found to be more effective when thus ploughed in, in its fresh state, than when rotted as dung.

It must also be borne in mind, that in the case of soils of this character, the mechanical cultivation is as important or more so than the right application of manures.

In crude undeveloped soils much working in this manner is necessary to make them remunerative at all, while to attain a higher degree of fertility, a constant and costly process of cultivation is requisite. Judging from the samples now reported on, I should conceive that the use of steam cultivation would be found admirably suited for this purpose if the nature of the ground would at all admit of it. I mention this because the full remunerative effect of the manures above recommended is not likely to be obtained unless supplemented by a proper condition of the soil.

RESULTS OF ANALYSIS.

OF 4 SAMPLES OF SOILS, MARKED A., IN AIR-DRY STATE—

	No. 9	No. 8 (Peaty soil)	No. 10	No. 11
Moisture	1·24	4·17	2·20	3·14
Organic matter and water of combination	5·13	71·32	6·34	7·24
Oxide of iron and alumina	10·32	4·43	11·39	9·76
with phosphoric acid equal to phosphate of lime	·12	·04	·09	·13
Lime	traces	6·70	traces	—
Sulphuric acid	·24	traces	·17	·17
Magnesia	.37	·34	·40	·32
Potash	·40	·26	·53	·64
Soda	traces	·12	·02	traces
Silica and insoluble silicates	82·30	12·66	78·95	78·73
	100·00	100·00	100·00	100·00

OF 2 SAMPLES OF SOIL MARKED B., IN AIR-DRY STATE—

	No. 23	No. 24
Moisture	4.32	3.20
Water of combination and a little organic matter	11·26	10·93
Oxide of iron and alumina	11·67	10·78
with phosphoric acid equal to phosphate of lime	·14	·07
Lime	·17	·12
Sulphuric acid	·07	traces
Magnesia	·64	·37
Potash	·36	·54
Soda	·07	traces
Silica, &c.	71·44	74·06
	100,00	100,00

Of 3 Samples of Soils marked C., in air-dry state—

	No. 5. also No. 20.	No. 13. also No. 21.	No. 38. also No. 22.
Moisture	3·40	2·87	4·17
Organic matter and water of combination	12·07	6·53	13·63
Oxide of Iron and Alumina	9·12	14·22	7·36
with phosphate	·10	·16	·12
Lime	·46	traces.	·24
Sulphuric Acid	·31	·32	traces.
Magnesia	·56	·27	·27
Potash	·42	·64	·38
Soda	traces.	traces.	·07
Silica and insoluble silicates	73·66	75·15	73·88
	100·00	100·00	100·00

Of 3 Samples of Soils marked D., in air-dry state—

	No. 1. also No. 17.	No. 2. also No. 18.	No. 3. also No. 19.
Moisture	1·90	1·73	2·40
Water of combination and a little organic matter	8·37	5·62	6·63
Oxides	9·26	11·37	12·73
with phosphate	09·	·08	·11
Lime	·22	traces.	traces.
Sulphuric acid	·19	——	·24
Magnesia	·71	·52	·30
Potash	·52	·39	·46
Soda	traces.	·07	traces.
Silica, &c.	78·83	80·30	77·24
	100·00	100·00	100·00

Of 3 Samples of Soils marked E., in air-dry state—

	No. 1. also No. 12.	No. 2. also No. 13.	No. 3. also No. 14.
Moisture	1·37	1·37	2·28
Water of combination and traces of organic matter	7·27	8·38	6·39
Oxides, with	13·38	14·22	13·22
Phosphate	·06	·08	·05
Lime	·17	traces.	traces.
Sulphuric Acid	traces.	·24	·29
Magnesia	·52	·57	·67
Potash	·31	·30	·29
Soda	·14	·10	·08
Silica, &c.	76·84	74·82	76·78
	100·00	100·00	100·00

Of 4 Samples of Soils marked F. and G., in air-dry state—

	F. No. 19, also No. 25.	F. No. 26.	G. 14 No. 16.	G. 13. No. 15.
Moisture	1·04	1·73	1·37	2·20
Organic matter and combined water	10·37	7·32	6·58	5·73
Oxides, with	11·37	7·64	14·32	14·36
Phosphate	·16	·17	·08	·13
Lime	·14	·63	traces.	traces.
Sulphuric acid	traces.	·14	·17	·15
Magnesia	·24	·26	·37	·63
Potash	·31	·30	·32	·32
Soda	traces.	traces.	traces.	traces.
Silica and insoluble silicates	76·53	81·98	76·87	76·61
	100·00	100·00	100·00	100·00

Of 4 Samples of Soils marked H., in air-dry state—

	No. 1. also No. 4.	No. 2. also No. 5.	No. 3. also No. 6.	No. 4. also No. 7
Moisture	3·20	2·40	3·42	3·47
Organic matter and combined water	6·37	5·83	11·34	4·76
Oxide of iron and alumina	11·92	12·43	*9·26	12·87
with phosphate	·07	·03	·12	·03
Lime	traces.	traces.	2·13	·63
Sulphuric acid	·24	·17	·32	traces.
Magnesia	·32	·53	·27	·42
Potash	·40	·26	·34	·31
Soda	traces.	·08	traces.	traces.
Silica, &c.	77·55	78·30	72·92	77·54
	100·00	100·00	100·00	100·00

* Traces present in protoxide.

Of 3 Samples of Soil marked I., in air-dry state—

	Surface.	12 in.	18 in.
Moisture	3·14	2·40	2·96
Organic matter, &c	6·73	5·38	4·90
Oxides	11·24	13·13	13·98
with phosphates	·06	·10	·03
Lime	·12	traces.	traces.
Sulphuric acid	·10	traces.	traces.
Magnesia	·34	·47	·52
Potash	·28	·33	·40
Soda	traces.	traces.	traces.
Silica, &c.	78·05	78·29	77·24
	100·00	100·00	100·00

Of 3 Samples of Soils marked J., in air-dry state—

	Surface.	12 in.	18 in.
Moisture	2·47	3·13	4·02
Organic matter, &c.	7·83	6·02	5·87
Oxides	11·52	12·44	12·77
with phosphates	·12		
Lime	·10	traces.	traces.
Sulphuric acid	·09	traces.	traces.
Magnesia	·32	·37	·42
Potash	·30	·42	·50
Soda	·14	·08	traces.
Silica, &c.	77·23	77·54	76·42
	100·00	100·00	100·00

Of 3 Samples of Soil marked K., also No. 2, in air-dry state—

	Surface.	12 in.	18in.
Moisture	4·14	3·92	4·53
Organic matter, &c.	6·55	4·28	5·20
Oxides	11·29	12·97	13·24
with phosphate	·10	0·6	0·3
Lime	traces.	traces.	traces.
Sulphuric acid	·15	·10	·08
Magnesia	·32	·35	·34
Potash	·40	·64	·55
Soda	traces.	traces.	traces.
Silica, &c.	77·15	77·74	76·06
	100·00	100·00	100·00

Of 3 Samples of Soils, marked L. and M., in air-dry state—

	L. No. 27.	L. No. 28.	M.
Moisture	3·14	2·97	2·23
Organic matter and combined water	5·37	6·20	7·17
Oxides	12·76	13·32	11·29
with phosphate	0·8	0·6	0·7
Lime	traces.	traces.	·17
Sulphuric acid	·24	·17	traces.
Magnesia	·37	·46	·63
Potash	·24	·37	·44
Soda	traces.	traces.	·12
Silica, &c.	77·88	76·51	77·95
	100·00	100·00	100·00

ON THE VARIOUS SYSTEMS OF TRAMWAYS.

By Count D'Adhemar,
Director of the Guadeloupe Concretor Central Factory.

Of the Wheel.

Vehicles to be used on tramways generally have two couples of wheels, sometimes more, and it is necessary that the parallel position of the axles should be modified when traversing a curve, so that a line drawn through each of them should converge at a point which would also be the centre from which the curve of the way is struck.

The accomplishment of these conditions presents in practice some grave difficulties, because it is needful to be able to subvert at a given point the parallelism of the axles of the wheels on the framework of the carriage, and to change at the same time in each couple the radius of the wheels, so that the prolongation of these axles may all converge towards the centre of the curve of the line, which may be suddenly approached in the course of travel.

As often as the course diverges, so often will it be needful to vary the relative position of the wheels and the convergent angles of the axles.

It is easily understood that in the surveying for a railway, limits might be placed to the conditions of the problem, by dealing with the obstacles presented by the soil in such a manner as that the curves of small radius might be reduced to two kinds, or even one kind, all through the line. In the latter case the relation of the wheels and the convergence of the axles would be reduced to unity of system.

The question brought to these terms, we might here indicate by what arts of construction of the road and of the rolling stock a practical application of the theory might be arrived at; but a full exposition would extend beyond the limits of our work, and we must be content to glance at the subject further on.

Notwithstanding the inconveniences belonging to the system of wheels fixed on their axles, this plan has been adopted on railways. Thus a line with sharp curves is a constant source of anxiety with railway engineers. Their only resource is to avoid them by diverging as little as possible from a straight line in laying out the road. The curves which they adopt, when circumstances render them needful, have generally for their smallest radius a distance of 450 metres (492 yards) at least.

At the same time they find it necessary, even for the roads with these large curves, to adopt every available expedient, in the construction both of the rolling stock and of the roadway.

Thus with the aim of favouring the convergence of the axles of the wheels to the centre of the curve they leave to the bushes of each axletree a certain lateral play in the frames, which are placed above on these bushes themselves, and which serve as support for the framework of the carriage.

Further to remedy then the inconveniences of the fixed system of each couple of wheels, the felly of each wheel is so constructed as to favour as much as possible in running over a curve the alteration of position necessary to the circumstances. In fact the exterior wheel thrown from its regular course by centrifugal force, is pressed against the outer rail; it thus rolls on that part of the felly of the greatest diameter, whilst the interior wheel following the movement, tends on the contrary towards the middle of the roadway, and rolls on the part of the felly of smallest diameter.

Again as a last expedient care is taken to elevate the rail of the outer curve above that of the inner curve. We allow that by this disposition an efficacious check is opposed to the centrifugal movement of the wagons, and that these are thus kept more forcibly within the curve of the road. But beyond this forcible check, operating at the expense of the *materiél*, has any good scientific reason ever been given for thus raising the outside rail? For to be right, the inside rail ought always to be placed lower than the outside, which should be kept on a regular level.

We now proceed to illustrate this.

In these turns of the road we have seen that the interior curve which is formed by one of the rails is shorter than the exterior curve formed by the other. It is evident that if by any means it becomes possible to render these two curves equal, the difficulties of a curvilinear road will be overcome, at least for an isolated couple of wheels, since the distance that each of the two wheels would have to clear would require each to make the same number of revolutions.

We will attempt the solution of this problem, as much to show the inconveniences which would be encountered in the application, as to explain the *rationale* of raising the outside rail.

We will represent (fig. 1) by the two concentric curves, M and N, having the same centre, O, the tracks of two rails, right and left, which a given couple of wheels must follow.

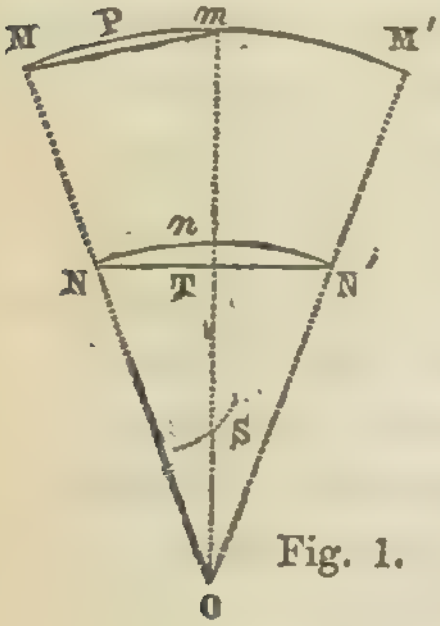

Fig. 1.

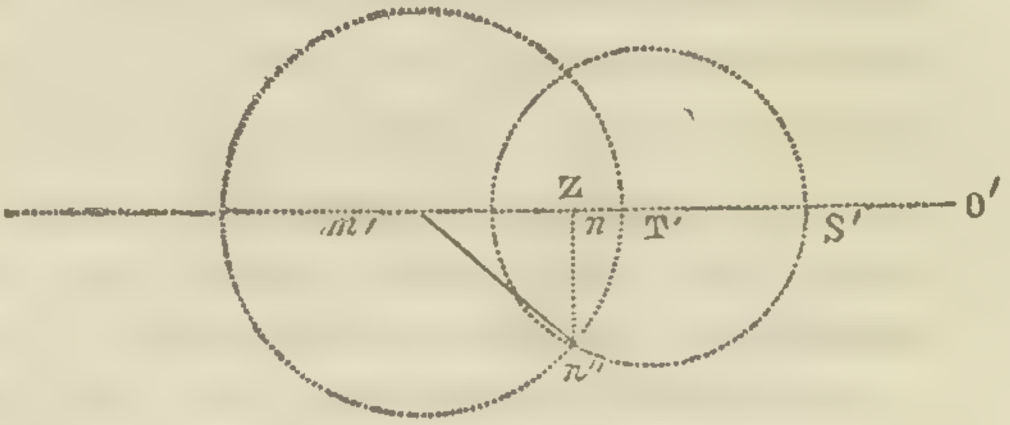

Fig. 2.

The course of these curves is limited to the two radii, O, N, M and O, N', M', where the curvilinear portion is bounded by two straight roads.

The only admissible supposition is that the exterior curve, M M', which has the greater radius, must be preserved, and the modification carried out on the interior curve, N, N'.

It is evident that the new curve which is to replace this must always be found at the same distance from the rail M, M', equal to the breadth of road M, N. It must not leave the surface of an annular cylinder, which should have for its axis the circumference M, M', and for the normal section of this axis a small circle with a radius equal to M, N.

We will take a point of this section the point *m* equidistant from the two points M and M' of which the section is shown (fig. 2) by the circle *m' n'*.

In this small circle the centre *m'* indicates the exterior curve and the point *n'* of its circumference upon the horizontal line *m'* O', the original interior curve.

If we join (fig. 1) the extremities N and N' of the interior curve by the chord $N N'$ this will cut at right angles the radius $o\,m$, at the point T. Making (fig. 2) $n'\,T'$ equal to $n\,T$ (fig. 1) the new point T' will represent on the figure of the section the chord $N N'$ itself or its projection.

It is evident that the point on the curve of substitution, corresponding to the point m on the exterior curve, must be found somewhere upon the (small) circumference of the sectional circle m', while at the same time its curvilinear distance from the point N must be equal to the curvilinear distance of the point m from the point M; but instead of determining this point by the curve, we shall have recourse to the chord $M\,m$, to obtain an equivalent solution of its position. With this chord we describe from the point N as a centre an arc of the circle S, which cuts in S the common radius $O\,m$, and gives the distance $T\,S$. This, carried to fig. 2, enables us to describe a circumference $T'\,S'$ from the centre T'.

It is evident the contact of this new circumference with the circumference of the sectional circle m' gives us the point n'' of the curve of substitution corresponding to the point m, and consequently the right angled triangle $n''\,m'$ necessary to the establishment of this same point n'' on the ground; $m'\,n''$ will be the track of the road on the vertical section of figure 2.

We see that we may determine by this same process another point on the substituted curve, corresponding to a second point P of the exterior curve, situated between M and m, and that we may thus construct between the two points N and N' an interior curve equal in curvilinear length to the exterior curve, since each point of this new curve will be as far removed from the extreme points, as each corresponding point of the curve $M\,M'$ is from the extremities M and M'.

But if we cast our eyes on the track $m'\,n''$ of the road, we see that in cases where the radius $T'\,S'$ is considerable, the solution will be impossible, or practically inadmissible, because, whilst on the one hand we are hampered by the very limited width of the road, as represented by the radius $m'\,n''$, we are, on the other hand, restrained by the fear of giving to the track $m'\,n''$ of this road too great an inclination, thus tilting up the carriages in such a way as to inconvenience the travellers.

(To be continued.)

ON A NEW OPTICAL SACCHAROMETER.

By John H. Jellett, M.A., [illegible]

(Fellow of Trinity College, and Professor of Natural Philosophy in the University of Dublin.)

[Read before the Royal Irish Academy.]

The author said that his attention had been directed to the possibility of applying the new analyzing prism, the construction of which he had described to the Academy some time since, to the construction of a saccharometer, capable of giving more accurate results than those obtainable by means of the instrument of Soleil. Having described this latter instrument, he said, that as far as he could judge, both from his own experiments and the report of others who had used it, the error to which even an accurate observer would be liable in attempting to estimate the strength of a saccharine solution, could not be reckoned as less than half a grain per cubic inch for a single observation. Having stated what he believed to be the cause of this want of accuracy, the author exhibited and described the instrument which he had himself devised for the same purpose. Of this instrument, the accompanying diagram (Fig. 1) is a representation.

aa is a short tube, containing two large lenses, serving to condense the light of a lamp, which is placed as nearly as possible in the principal focus of the lower lens. *bb*, *cc*, is a short tube, carrying at one extremity a lens, *cc*, and at the other extremity a diaphragm, *bb*, pierced at its centre by a very small hole, *O*, which is situated in the principal focus of the lens *cc*, and also, when the instrument is adjusted, in the principal focus of the upper lens *a*. By this arrangement a beam of light is obtained emerging from *cc*, sensibly parallel to the axis of the tubes. This beam is polarized by being transmitted through a Nicol's prism, contained in the tube *dd*. *ee* is a vessel, pierced at the lower end by a circular hole, which is closed with plate glass. This vessel contains a fluid, possessing a rotative power opposite to that of the fluid under examination. This latter fluid is contained in the tube *ff*, which rests on the two upright pieces *yy*. These pieces are attached to the transverse piece *vv*, which carries a vernier, whose divisions correspond to those of the scale, *ss*, which is attached to the bar *zz*, which carries all the parts of the instrument. The transverse piece, *vv*, is capable of sliding along *zz*, this motion being produced by a chain, attached at both ends to *zz*, passing round a spindle with a milled head, attached to *vv*. By these means a motion can be given to the tube *ff* parallel to its own axis; and, by a very simple arrangement, the zero of the vernier is made to coincide with the zero of the scale, when the extremity, *f*, of the tube is in contact with the piece of glass covering the lower aperture in the vessel *ee*. It is plain, then, that the numbers read on the scale, which is graduated so as to be read to 0 inch ·001, will denote the length of the column of fluid *E F* (Fig. 2) interposed between the bottom of the vessel and the bottom of the tube. *gg* is an analyzing prism, constructed as before described.* *hh* is a lens, and *l* a diaphragm, with a small hole, at which the eye of the observer is placed. The polarizing and analyzing prisms are fixed in their places by small screws, σ, σ', each passing through a transverse slit in the outer tube, so that when partly unscrewed they allow the prisms to turn through a small angle round the axes of the tube. In using the instrument, the polarizing prism may be set in any position, the analyzing prism being then carefully adjusted, so that the tints in the two halves of the circular spectrum† may, when there is no fluid interposed, be exactly equal.

Suppose now that the object is to ascertain the strength of a given solution of cane sugar. In this case, the fluid to be used in the vessel, *EE*, may be French oil of turpentine. A certain quantity, the amount of which depends on the strength of the solution to be observed, having been poured into the vessel, the tube, *ff*, is then filled with a solution of sugar, whose strength is accurately known. The tube is now replaced in the upright pieces, and the zero of the vernier made to coincide accurately with the zero of the scale. The milled head is now turned so as to draw back the tube until the tints on the two parts of the circular image, seen through L, become equal. The number on the scale corresponding to the zero of the vernier is then noted. Let this reading be R, and let S be the strength of the known solution.

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* "Proceedings of the Royal Irish Academy," vol. vii., p. 348. † Ibid, p. 349.

Now, let this solution be removed from the tube, which is then to be filled with the solution whose strength is required. The same process having been gone through, let the new reading be R′; then the strength required is given by the equation—

$$S' = \frac{R'}{R}. S.$$

If the experiment be carefully conducted, and if there be no error in the strength of the standard solution, the error in the measurement made, as above described, ought not to exceed 0 grs. ·02 per cubic inch for a single experiment. If the mean of a number of experiments be taken, the error would, of course, be still less.

The author has given to this instrument the name saccharometer, derived from one important use to which it may be applied. This, however, is but one of its applications; and there are many others, at least as important. It may generally be defined to be an instrument by which the ratio of the rotatory power of any transparent fluid to that of a standard fluid may be accurately determined.

It is not desirable to use a very strong solution of the substance to be examined. The reason of this is the imperfect compensation which exists between fluids possessed of opposite rotatory powers. It is generally assumed that the ratio of the rotation produced in the planes of polarization of any two of the simple rays of which a white ray is composed is the same, whatever be the substance causing the rotation. It follows, indeed, from the law of Biot, that this is not accurately true, but it has been generally supposed that the error is too small to be perceived. If this were true, it would always be possible to assign to the lengths of two columns of oppositely rotating fluids such a ratio, that the effect of the one should be accurately compensated by the effect of the other. But the author has found that in certain cases the error is very perceptible indeed. This is shown by the impossibility of giving to the tube *ff* any position in which the shades of colour are exactly the

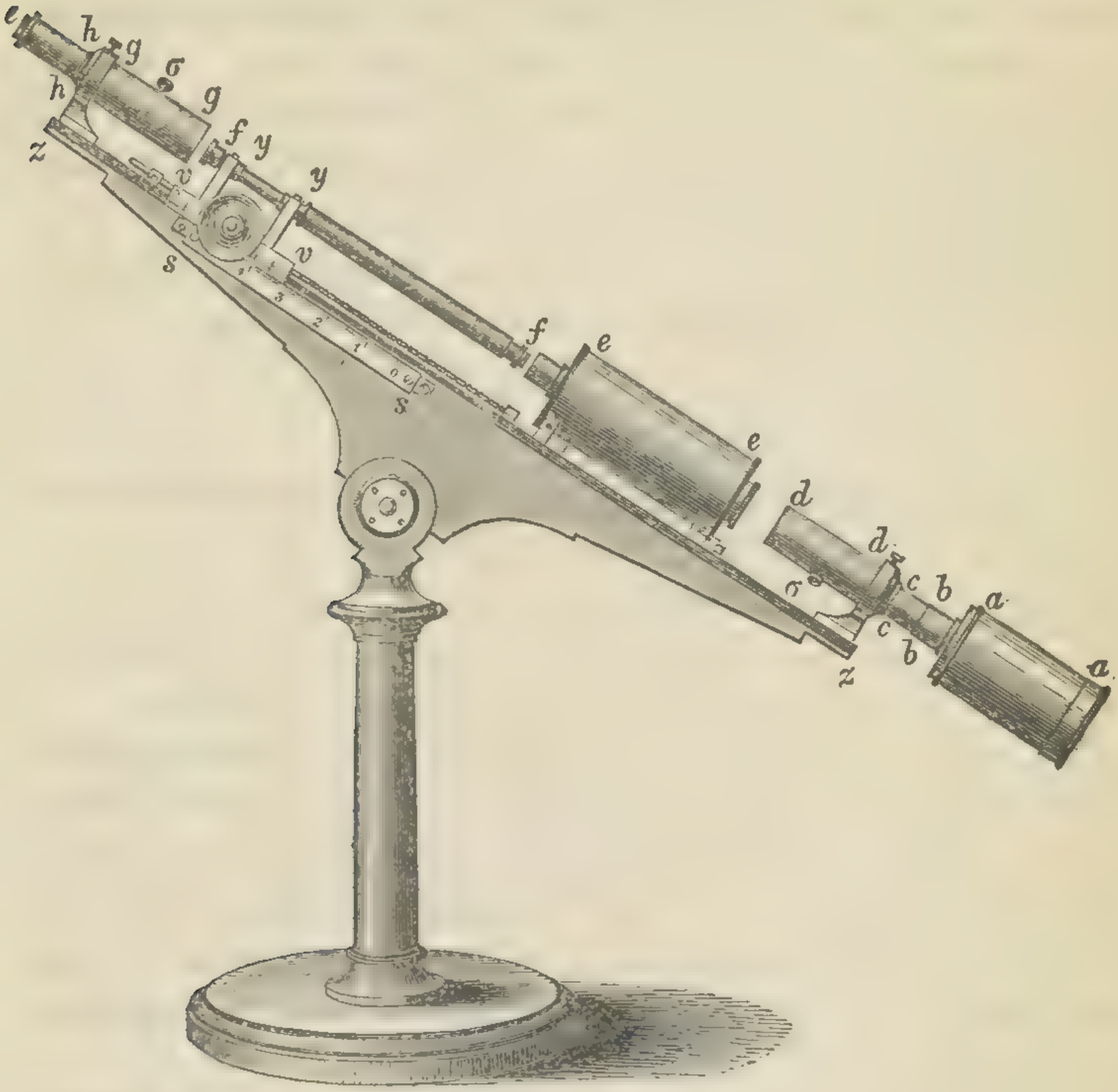

Fig. 1.

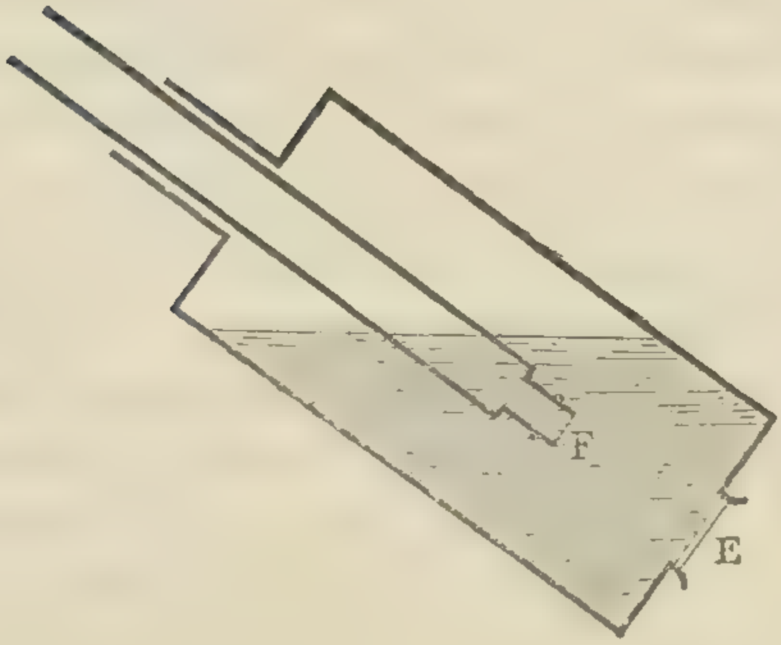

Fig. 2.

same in the two parts of the circular image. Suppose, for example, that the position of the tube is such that the plane of polarization of the mean ray has the same position as at first. This plane is then equally inclined to the planes of analyzation of the two parts of the analyzing prism. But this is not true of the planes of polarization of any of the other rays; of these, the less refrangible will have their planes of polarization nearer to one of the planes of analyzation, while those of the more refrangible are nearer to the other.

There will therefore be in the one half of the image a preponderance of red light, and in the other a preponderance of blue light, when the intensities of the two parts are equal. The difference of colour, which makes it difficult to equalize these intensities with perfect accuracy, will evidently be greater, the greater the amount of the rotations which the compensating fluids would severally produce, and therefore the greater the strength of the solution.

On the other hand, it must be remembered that the error in the result, arising from an incorrect position of the tube, is inversely proportional to the length of the column of the compensating fluid. Thus, if the reading of the scale be ·1, an error of one division, or ·001 will have the same effect on the result, as an error ten times as great would have, if the reading were 1·000.

No general rule can be given for determining the strength of the solution which it is desirable to use. If the law of Biot, sc.,—that the amounts of rotation produced by the same substance in the planes of polarization of the different simple rays are proportional to the squares of the corresponding refractive indices—be strictly true, then, the more nearly these indices are in the same proportion for the fluid under examination and the compensating fluid, the stronger may be the solution used. If the fluid under examination be a saccharine solution, and the compensating fluid French oil of turpentine, a solution containing, in each cubic inch, thirty grains of sugar, may be used without inconvenience.*

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* The instrument here described was constructed by Messrs. Spencer and Son, of Aungier-street, Dublin, to whose ability, both in carrying out the instructions given to them, and in suggesting methods for overcoming practical difficulties, the author is much indebted.

STEAM CULTIVATION *V.* COOLIE IMMIGRATION IN BRITISH GUIANA.

BY JOHN SCOTT.

From the "Royal Gazette."

During thirty years' progress of immigration, the colony has grown and prospered. There is a flaw, however, in the immigration system to which no amount of present prosperity should blind our eyes. If by any chance immigration were to fail now—and it is not an improbable contingency—the colony would be no better off for labour than it was when immigration began! The meaning of this is as plain as need be, at a time when it is hinted that the future supply of immigrants from India may possibly be withheld, and when, on any calculation, the introductions will not amount to more than one-sixth of the number applied for this year. It is natural, of course, to cast about for other fields which offer a supply of immigrants, but no such scheme is ever likely to afford a true solution of the problem before us. Coolie immigration is a mere makeshift; it provides for the present, but it leaves the real question at issue to be brought forward and dealt with at a future time. In order to be of permanent utility to the colony, a continuous stream of immigrants would need to be poured in until the labouring population was *three hundred* times greater than it is now!

But though British Guiana enjoys the reputation of being one of the most sparsely peopled countries in the world, it owns an agricultural population roughly estimated at 600 to the square mile of land cultivated. It is well, therefore, when we hear of the necessity which is supposed to exist for the introduction of a constant supply of foreign labour, so continuously and so persistently urged by the planting interest in general, to consider by what means other and less fertile countries thrive on a twentieth part of the labour with which British Guiana finds it so hard to struggle along. As a matter of fact, the countries referred to have substituted field machinery for manual labour to an incredible extent, while here no other implement of tillage is in use save the primitive *spade* and the *hoe*. It is from this neglect of labour-lessening implements that all the scarcity of labour in this colony proceeds. If the system of agriculture pursued was adapted to the spirit and necessities of modern times, there would not only be no need of immigration, but cultivation might be extended almost indefinitely with the labour which is now available. I am told, however, that such a thing is impracticable; that the use of machinery does not apply here; that the present system is the best and most suitable which it is possible to devise. These are common, and as I think, erroneous views. Experience tells us there are few things so widely applicable to the wants of a country as improvement in the tillage of the soil. The principles involved in the application of machinery to the cultivation of the soil are both few and simple. It only needs that the surface of the ground be rendered uniformly level; that any impediments to the action of the implements be obliterated or removed; and that an easy and ready means of transport be provided for heavy modern implements and machinery. Those who try to jump at the end without using the means will certainly be found to say that the thing is impracticable; but no one, I venture to say, will arrive at this conclusion who makes a right application of the means.

A better illustration of the principle which is here laid down could not be wished for than is met with in the history of steam cultivation in this colony itself. Strange as it seems, two of the earliest pioneers in this work were planters in Demerara. Forty years ago, Mr. McRae patented and introduced a set of steam cultivating machinery, the engine and pulleys of which were moved in punts placed on the navigation canals, at opposite sides of the field. Again, in 1846, Mr. Osborne is recorded as one of the first who ploughed with two engines, one at each end of the field. Neither of these attempts appears to have been successful. Indeed, all things considered, it might have been counted the eighth wonder of the world if they had. They had not the perfect machinery which we now have, nor was subsoil drainage and the art of adapting the land to this system of cultivation sufficiently understood. The question seems to have rested there till a few years back, when the colony offered a premium of 5,000 dols. for the best application of steam power to the cultivation of the soil. This was awarded to Messrs. John Fowler and Co., of Leeds, for the improved application of the double engine or direct system of cultivation, the engines being placed in punts, after Mr. McRae's example. As far as I know, there is only one set of this tackle at work in the colony, and that is on Pln. Montrose, East Coast, where the enterprise has been gone into in a very judicious way. The land has been under-drained and levelled before making use of the machinery, and the result is that both the tile-drains and the steam-plough are working successfully.

Montrose, it may be added, is drained by machinery, as most of the Coast estates are. On the river, I think that the natural discharge would suffice for tile drainage; but evidently where a draining engine is needed it is the planter's own interest to provide it, whatever may be the method of cultivation. If expense is no object, the best drainage of these tidal lands will certainly be where the discharge is natural and assisted by machinery, for then perfect drainage is insured either way; but our present argument is, that where the natural discharge is satisfactory with open drainage, the planter need not necessarily incur the expense of machinery in adopting tile drainage. Altogether the cost of covered drains is far less than many think. They are greatly more effective than open ones in draining from the body of the soil, and therefore, if the present arrangement of the drains is adhered to in the new system, the drainage will still be more complete. It, then, only requires to dig out a bed in the bottom edge of the old drain, to lay the pipes and cover them; and this I was assured is done for 6 dols. per acre at Montrose. Drain-pipes, 4 inches in diameter, can be manufactured on any estate for 8 dols. per thousand, including every expense; and with the drains 3 rods apart the cost of the pipes would be 9 dols. 88 c. per acre. Levelling, if done entirely by means of spade labour, would be very expensive; but as the plough is a much more powerful and useful instrument for the purpose, the spade need only be used to set the plough at work, and the cost of the operation should not thus exceed 6 dols. per acre.

The Montrose experience is valuable as showing the possibility of what so many declare to be impracticable. The scheme, however, is not complete enough for a perfect economy. The fields are too small and the trenches which intersect the land are too numerous to admit of a proper day's work being done with the machinery. A good deal of reflection on this point confirms me in the opinion that these trenches must be done away with as steam cultivation is advanced. The loss of time even which they occasion in working is very considerable. If we take and cultivate the usual distance from punt trench to punt trench, 148 yards, with an implement covering 7½ feet ground, there will be 13 turns per acre. Now, if the time lost is three-quarters of a minute at each turn, and the working power of the implement is only 2 acres per hour, the time lost in a working day of ten hours will be two hours and thirty minutes, and the work done will only be 15 acres. But increase the length cultivated to 400 yards, and there are only 4½ turns per acre. The loss of time will then be one hour in ten, and the work done will be 18 acres! It would clearly be a backward reform to double the width between the trenches, as that would upset the main object of their arrangement altogether, which is to facilitate the carrying out of the canes. It is equally clear, however, that it would not pay to transport canes as is now done, once the land is under-drained and levelled, as the cane fields could then be cleared by wagons or some cheaper means. There is, therefore, nothing for it but to substitute roads for trenches.

Very few roads are needed to afford the facility contended for where the contour of the land is flat, as with the coast lands of Guiana. If we suppose an examplo estate of 1,000 acres to be 200 rods façade and 1,500 rods in depth, a road at each side line and one central road will serve every purpose of cultivation. There would be thus 18,500 lineal yards of road to construct. In a country where no better road metal is to be found, the road would have to be formed of burned earth, or ballast as it is sometimes termed. To dig and burn the clay will cost 32 cents per lineal yard, and the fuel, of which an expert burner takes very little, will make the cost of the road say 48 cents per lineal yard. It is, therefore, pretty safe to say that the most liberal expenditure on preliminary improvements which is demanded by our system would not exceed 30 dols. per acre. The outlay would stand thus:—

	dols.	c.
Drainage	15	88
Levelling	6	0
Roadmaking	8	88
	30	76

But apart altogether from the requirements due to the introduction of modern implements and machinery, the works advocated are most valuable improvements in themselves, and, if no further end was in view, it would pay the planter well to adopt them. In the present arrangement of the land, an estate of the size named loses no less than 260 acres by the use of open drains and trenches, and this exclusive of middle and side line walks and drainage canals. This represents an annual loss of at least 40,000 dols.; while, as will hereafter be gathered from our statement of expenses, the land which is thus wasted costs nearly as much labour as if it were under crop. In this consideration I omit all account of the influence which open drains and trenches have on the growth and spread of weeds and grass, though no one can doubt that this influence is very great.

There are, no doubt, great economies suggested in the proposed improvements, yet they are only the means to an end. It must not be forgotten that what I chiefly advocate here is *the possible economy of labour and expenditure* to which these improvements lead. It is clearly the interest of the colony to promote a scheme which professes to secure these ends. Even if the present labour force was stable and self-supporting—suppositions which are not to be allowed—it is more than probable that the rapid extension of sugar production, and the increasing dependence on mechanical appliances in other countries, would soon oblige the planter to substitute a more economical power. This necessity, it is obvious, must be far greater when the labour force of the colony is a perishable commodity, and is supported not only with much difficulty, but at an enormous annual expense.

This expense increases in proportion with the number of labourers that are under indenture; and as many advocates of coolie immigration think it a misfortune that they cannot obtain twice the number of immigrants that they now do, it may be well to ask them to consider this outlay. On a safe calculation, there is one immigrant for every two acres of land cultivated. On some estates, doubtless, the proportion of immigrant labour is less, but on others again our estimate is greatly exceeded. I will, therefore, suppose an estate of 1,000 acres to have 500 immigrants. As the term of indenture is for five years, the number will be diminished one-fifth every year. But mortality makes a further reduction of say 3 per cent. per annum; so that, in reality, 115 immigrants must be indentured annually in order to keep up the labour force of the estate. Taking the cost to the planter at 50 dollars each, this amounts to 5,750 dollars in a year.

In this consideration we must also include the expense of maintaining these immigrants in times of sickness, and of providing a hospital for them on the estate. No solitary estate, and indeed, no single locality would give a fair idea of this expense.

But according to Dr. Shier's report on estates' hospitals for 1870, there were 50,237 Asiatic immigrants resident on estates, and out of that number there were no less than 103,864 admissions during the year into estates' hospitals. Now, if we adopt Mr. Russell's figures, 11·87 days to each admission, it gives 24·54 days in hospital for every immigrant. Of 500 immigrants there will be thus 33·61 entirely lost to the estate, or more than 6½ per cent. of the whole daily in hospital. The daily expense of a patient may be taken as follows:—

	c.
Food	12
Medicines	4
Nurses and staff	4
Doctor	6
Interest and depreciation on erection of hospital—say, on 15,000 dols. at 5 per cent	6
	32

Accordingly, as there would be 12,270 day patients in a year, the hospital expenses will amount to 3,926 dols. 40 c. Of course when the new immigration bill becomes law our estimate will be modified to the extent of the doctor's salary. As things now are, however, the proportion of immigrant labour which is usually employed to cultivate an acre of land on a sugar estate in this colony annually costs :—

	dols.	c.
For immigration or indenture fees	5	75
Hospital expenses	3	92
	9	67

On the other hand, while the expenses arising from the employment of machinery form a large share of the general expense, they are very trifling compared with this sum. A pair of Fowler's 12-horse engines, with ploughing tackle and implements complete, will cost 8,000 dols.; and 20 per cent. on that outlay, to cover interest, tear and wear, and depreciation, is only 1,600 dols. per annum, or 1 dol. 60 c. per acre.

With this brief reference to the establishment and support of the labour powers of the two systems, I will now proceed to describe the different methods and expense of working.

Let us suppose that in the present system one-third of the land is annually replanted, and that the other two-thirds produce respectively first and second ratoon canes. The rows of canes are practically six feet apart, the land being laid out in three feet cane rows and three feet banks.

In relieving, which is the first work after cutting, the refuse of the old crop is carefully gathered up, with any weeds or grass which has vegetated since the last weeding, and neatly banded in rows, so as not to interfere with the operations which follow. When the land has to be replanted, the trash is laid on every alternate row of the old crop; otherwise, it is put on every alternate bank. The cost of this operation varies from 2 to 3 dollars per acre. I think it right, however, in our estimate of expenses, to assume that on the portion of land replanted the trash is disposed of by burning. This, including the labour of first putting the cane tops into the small drains, may be done for 80 cents per acre.

The land is then replanted or supplied. In the former case, the three feet bank is shovel-ploughed and planted with a centre row of cane tops; in the latter, the soil is earthed up around the old stools, and tops are put in to fill up the blanks. Replanting costs 8 dols. per acre, and supplying, half that sum, or 4 dols. per acre. Practically it costs a great deal more to obtain a good stand of canes. Owing to the imperfect drainage conditions of the soil, a season of wet or dry weather seldom occurs without a considerable loss of young plants; and if the planter does not see to it, and be active in having the blank spots supplied or stumped up, the probability is that the crop will not be worth much. At times the field has to be gone over two or three times in this way, but invariably once, at an expenditure of perhaps 2 dols. per acre.

The drains, as a rule, are dug out once a year. To every acre there are 80 rods of two feet drain, and 10 rods of four feet drain, and as the former is dug at 2 cents and the latter at 4 cents per rod, the operation costs exactly 2 dollars.

The usual practice of manuring is no credit to the system. It costs one dollar per acre to dig a hole at each stump or plant and put in the manure with a spoon! And what follows? The effect of manure placed in the ground in lumps or heaps is not only trifling, but often, from improper covering, a great portion of the manure is washed off the land and flows away through the open drains.

While there is some variety in the tillage which is pursued after planting, it is much less than may at first appear. The following is probably a liberal construction of the practice throughout the colony. In the first year the banks are shovel-ploughed or forked; in the second year every second bank is drilled; and in the third year the trash is buried on the bank which is left. Experience proves that a man can fork nearly one-fifth more than he can plough with a shovel, yet I have never noticed any such distinction observed in the prices paid for the work. The same, in fact, is usually paid for forking as for shovel-ploughing—8 dols. per acre; and for forking and burying trash on every second bank, 6 dols. per acre. Drilling costs 8 dols. per acre.

It is significant that after all the labour and expense which is involved in these operations they do not amount to *one thorough tillage* in the year. There can be no argument, I think, in favour of sub-dividing the work. It is manifestly wretched husbandry to leave half the land untilled. Half-working means half-cleaning, and of course a great number of weedings must follow. It is some satisfaction to note that amongst high-class planters it is customary to bestow a greater proportion of the labour in stirring the soil and less to weeding purposes. Frequent deep cultivations render weeding altogether unnecessary; and if practised to any extent at all, it considerably lessens the number of weeding operations required. These modifications, however, must not be held to lessen the expenses of cultivation; on the contrary, they rather increase it; but they are only a few exceptions to a rule, and do not, therefore, present any appreciable limit to my statement as regards the expense or the amount of tillage which is provided for in the present system. Probably its worst feature is that, enormous as the labour force of the estate is, it is fairly inadequate for its purpose. The value of work done depends entirely on its being done at the right moment; and where extreme degrees of moistness and aridity are common, as in the climate of this country, timely and judicious cultivation of the soil must be very strictly observed if success is desiderated. The total inadequacy, in this respect, of a labour force which has to drag its slow length through all periods and seasons, is an evil which cannot be sufficiently deplored. If an attempt was made to estimate the loss which thus occurs to the planter, it would have to be summed up in time wasted, in labour thrown away, and in irreparable injury done to the crops.

A principal part of the labour is, therefore, bestowed in weeding and moulding the young canes and in weeding and trashing, operations which need to be repeated about once in six weeks. There are, say, six operations of the kind, and at 2 dols. each they amount to 12 dols. per acre.

The cost of cane cutting is calculated at 4 dols. per hhd. of sugar, and as I proceed on the assumption that the yield does not fall below 2 hhds. per acre, the expenses under this head will be 8 dols.

Loading and transporting canes is reckoned at 1 dol. per hhd., but the actual cost is a great deal more. In order to show this with some accuracy, I will here take into account the different items of expense in this consideration. To load and pick up the canes cannot be done for less than 12 cents per punt load, and as it takes six punts or so to the hhd. of sugar, this amounts to 1 dol. 44c. per acre. The lowest possible number of punts in use will be one for every 25 acres of crop. Now, the first cost of a wooden punt is at least 80 dols.; interest on which at 5 per cent. is 16 cents per acre; and as the wear and tear is equal to about 12½ per cent., the use of the punts may be said to cost 56 cents per acre. There are also the punt mules to be considered. The annual expense of a mule is as follows:—

	dols.
Feed and attendance	40
Harness	3
Risk	10
Interest of capital	5
	58

If, then, there is one mule for every 100 acres in canes, the expense will be 58 cents per acre. An extra driver at 3 cents per punt is 36 cents per acre more. And, lastly, there are navigation trenches to be kept in repair. It is rather below the mark to say that there are 9 rods of trench per acre to be cleaned or weeded once a year and dug bi-annually—say, weeding at 2 cents and digging at 16 cents per rod—in all amounting to 90 cents per acre. Transporting, therefore, must be taken at 3 dols. 84c. per acre.

I shall now recapitulate the chief articles of expense in cultivating an acre of land on the present system:—

	dols.	c.
Immigration and hospital expenses	9	67
Relieving	1	93
Replanting	2	66
Supplying	2	66
Stumping	2	00
Digging drains	2	00
Applying manure	1	00
Forking banks	2	66
Drilling	2	66
Burying trash....................................	1	99
Weeding and moulding.	6	00
,, and trashing	6	00
Cutting canes....................................	8	00
Transporting	3	84
	53	07

There is no longer any doubt that land may be as well tilled by means of good agricultural implements as by manual or spade labour, and at much less expense. The machines that are now used for this purpose are very numerous, and are adapted to the culture of almost every kind of crop. It is wonderful, indeed, to how many different crops the same instruments are found to apply. The implements of the farm afford nearly every requisite for the complete tillage of the sugar estate.

The following table exhibits the particulars of work held to be performed by the machinery :—

Implement.	Acres Worked.	Width taken by Implement.	Acres done per day.	Days at Work.
Cultivator............	3,000	7½ft.	20	150
Harrow...............	2,000	15	40	50
Drill plough.........	1,000	15	40	25

The tackle, it is seen, would be only 225 days in completing the annual tillage of 1,000 acres. As three men are required to work it, their labour would be equal to 675 days work of a man—say at 84 cents per day—amounting to 567 dollars for the year. The engines will consume 20 cwt. of coal in a working day, and, at 8 dollars per ton, that is 1,800 dollars. A further allowance of 24 cents per day for oil and grease provides for the whole expense of working the implements and machinery. It is shown thus per acre :—

	dol.	c.
Interest, wear and tear, &c.	1	60
Labour with tackle	0	56
Coal oil, &c..................................	1	85
	4	95

A great point in this system is that it almost entirely dispenses with the labour of hand weeding, which forms so large and extravagant an item in the present expenditure. It may be taken for granted that the canes are trashed *thrice*, as they now are, but as little or no grass would grow with the liberal cultivation for which

I have provided, the operations must be held to cost less. Our aim, however, is as much to improve on the present system as to lessen its expenses. To strip off the dry leaves is only a part of the hand labour which should be bestowed on the growing canes. No one need be told that sugar of the best quality can only be made from canes of equal growth and ripeness, yet it is staggering to note how little this point is attended to in general. The planter picks off the dry leaves, and weeds out the grass when it chokes the canes; but he never dreams of directing the growth of the plant he cultivates. Nothing, indeed, is more common than to observe springing from the same stole 20 or 30 canes, all of unequal age and ripeness. Many unripe canes are consequently brought to the mill, the effect of which is not only to make the juice poorer, but to render its manufacture into sugar more difficult. From the indiscriminate propagation of offshoots, too, the plants suffer in growth, so that, instead of the yield being greater, it is actually less. The offshoots which spring from the stole should therefore be carefully taken off when trashing. It is a work which can never be too much insisted on. Finer and better canes would be grown, the yield would be greater, and the process of manufacture would be simplified very much.

This, however, is less surprising when we consider how cultivation is applied. It is either in preparing the land before planting or in afterwards stirring and cleaning the soil at regular intervals. The first seldom or never varies (though different implements, as the plough or cultivator and the harrow, may be used) where the land is in a fit state of cultivation; and the latter may be said to vary only in the size and width of the implements which it is practicable to employ. Some crops are necessarily grown at wider distances than others, and, as in the case of the sugar-cane, the row culture admits of very large-sized implements being used. On steam cultivated estates it is not uncommon to employ the same cultivator in preparing the land and in cultivating between the rows, which, in such cases, are seldom less than eight feet apart.

Fowler's steam cultivating tackle consists of two self-moving engines, with winding drums, 800 yards of steel rope, and ten rope porters.; and, if the estate has been laid out as directed, the 12-horse set of this tackle should very well suffice for the cultivation of 1,000 acres in sugar-cane. The engines are worked on opposite roads, and haul the implement, which may be of any kind, to and fro between them, the engine not in work paying out the rope while moving forward into position for the return of the implement.

In working up the land for planting, the cultivator is chiefly used. This instrument loosens and stirs the soil, and cleanses it from roots and weeds, but does not turn it over like the plough. With an implement of this class, covering 7½ feet of ground, the power of tackle indicated will cultivate at the rate of from 20 to 30 acres per day. If a fine tilth is wanted, the harrow also must be used before the land is fit to plant.

It would evidently be working the machinery to only a fraction of its power if it was not employed to do more than prepare the land. Indeed, if the ground had to be planted and kept clean by manual labour, the benefits to be derived from the use of the machinery would be exceedingly small, as the diminution of labour would not then be proportionate to the expense. But the iron horse is tractable, and disposed to work. With a ridging plough it will mark out the land with light drills, three or four inches deep, in which to plant. If artificial manure is allowed, it is put into the bottom of the drill; then one or more cane tops are laid in horizontally, and the harrow used to give a slight covering to the whole. To apply manure in this way will only cost 12 cents per acre, as a man or a boy can do three acres per day. Planting will cost 48 cents per acre, one acre being about a day's work for a man and a boy.

I need hardly speculate on the effect which the facilities thus offered by our system would have on the practice of ratooning. The return from plant canes is much greater than from ratoons, and there would be nothing at all to prevent the planter raising them. It is simply ridiculous that fields should be patched up year after year, when it would pay better to replant the land.

Good culture should adapt the plant cane to make as good sugar as the ratoon, and it is all nonsense for people to argue otherwise. We know that very little agricultural skill is needed to produce rank canes which yield a poor juice, and consequently sugar of inferior quality. Such may be grown by a really injudicious application of tillage and manure, if it only favours a vigorous vegetation; but the highest art of the planter is to produce canes which yield a juice rich in sugar and easy of concentration. In our comparison of the two systems, however, I will not assume that an extra pound of sugar would be made by this means; but I feel sure that if the practice of annual replanting, and thoroughly working the land preparatory to it, was once adopted, it would be certain to result in very large additions to the estates' produce. As soon as the young canes are well sprung, the cultivator again comes in as a substitute for the shovel or the fork; and both as regards economy and efficiency of tillage, it far surpasses any shovel-ploughing or fork work which it is possible to do. It will work between the rows of canes, and stir the soil as close as need be to the growing plants. If this was done say *twice* after planting, it would keep the soil permanently loose and clean. Light mould-boards can be fitted to the outer tines of the cultivator, and the young canes moulded up if needed. In these after cultivations the work would be much lighter than in the operation which preceded planting, but as more care would be required amongst the growing canes, the time and expense of cultivating would be about the same in every case. For one crop the land would thus be *thrice* tilled against *once* in the present system.

There can be no doubt whatever that the adoption of the system I have sketched out would considerably lessen the labour and cost of cane cutting. At present the reaper has not only to cut the canes, but he must carry them to the parapet, where they are thrown down, to be lifted a second time by other hands engaged in loading and transporting. Now, there are from six to nine hundred bundles or head loads of cane to an acre, and as the average distance walked for and with each bundle is 70 yards, it amounts to 30 miles travel per acre. Not ordinary travel either, for half of the way the labourer has to carry a load of 75 lbs., and cross as many as 1,275 drains! But all this would be superfluous under the altered conditions which I propose; so that it is quite reasonable to conclude that the work would be done cheaper. The canes of course would be to tie in bundles for transporting; so also would the cane tops or seedlings, that they might be quickly collected before the trash was burnt on the ground. This, however, could be provided for, and the canes cut for one-fourth less than the present prices. And still our scheme does not limit the economy which is possible in this direction. There is no reason in the nature of things why canes should not be cut by machinery, just as well as wheat or beans are. A machine to do this work is one of the most pressing wants of the day, and where a necessity of the kind exists it ought, I think, to be provided.

Our road system will now be found to serve another expediency, by admitting of the use of traction engines in steam carriage. With a system of level fields and no ditches, the difficulty so commonly experienced on sugar estates, of moving a traction engine and wagons over the land, would be entirely obviated. To be sure there is Greig's system of clearing cane fields, in which two ordinary ploughing engines are placed on the opposite roads, their ropes being connected by a shackle, to which a spare chain is fixed. The wagons are attached to this chain and hauled over the field from one engine to the other, being steered along the uncut edge of the sugar-cane and loaded at the same time. This system applies particularly to very large estates, and where constant employment is afforded for the machinery. Where the employment is not so regular, a cheaper system may be looked for. It is just possible that a wire rope carrier might be employed with more advantage in clearing the land and delivering the canes to the wagons on the central road. I have shown, however, that the direct application of traction engines would not be inapplicable to the case before us, and I shall accordingly calculate the expense on this system. Two 8-horse-power traction engines (with India-rubber wheels) and six 4-ton wagons would have to be provided for 1,000 acres. If we suppose that there are 150 crop days, and that 7,000 dollars would cover the entire outlay for plant and machinery, the cost of loading and transporting an acre of canes would be as follows:—

	dol.	c.
Interest, tear and wear, &c., on 7,000 dollars, at 20 per cent	1	40
Engine drivers		32
Stokers		16
Coal and oil		96
Loading canes		56
Repairing roads		32
	3	72

This comes pretty near to the cost of transporting in the present system, so that as far as direct economy is concerned the difference is not worth mentioning. But I have already pointed out that other and most important economies would result from the adoption of road carriage, and there are others, quite as important in their way, which have not yet been referred to—such as the loss or damage by water canes; want of water and consequent delays; and the injury which is sustained at times where the trenches have to be replenished with salt water. These may appear trifling economies to some, but they all go to make up the profit or loss of the estate, and the system which has fewest loopholes is certainly the best.

The cost of cultivating an acre of sugar-cane by the aid of steam power stands illustrated thus:—

	dol.	c.
Tillage	4	01
Planting		48
Manuring		12
Trashing	6	00
Cane cutting	6	00
Transporting	3	72
Burning trash		48
	20	81

It is now seen that if the system I advocate were not recommended as affording a complete solution of all the difficulties which beset the labour question in this colony, it would still have a sufficient claim on the attention of the planter as greatly conducing to a true and prosperous economy of agriculture. A single year's saving in the labour bill would do more than cover the outlay on improvements, while the future profits would be many times greater than is now yielded by any estate. Even if half the results I have described were only obtained, they would be well worth striving for; yet the merits of this system are quietly ignored, while every means and invention are sought out to perpetuate another which is growing more feeble every day. Surely, if private enterprise will not push the matter to its issue, it is a fit question for the Royal Agricultural Society or the Planters' Association to take up. One of the avowed objects of the society "is to promote, as far as possible, the improvement and encouragement of the agriculture of the colony," and it should not sit idly by while so great a work is left undone. Let an experimental estate be established, and cultivated on rational principles, and it will show what a right application of means can do. It will produce more fruit in a year than the "village scheme" will do in a lifetime; and if one-hundredth part of the encouragement is accorded it which has been shown to "pet" immigration these many years, it will be found the most applicable of the two to the wants of a country which has been slow to recognise its claims.

Plantation La Grange, Demerara,
July, 1872.

ON THE INFLUENCE OF FORESTS ON RAINFALL.

By Alfred Fryer.

(Continued from page 536.)

"The wording of Government Resolution, No. 3514, of October, 1858, would seem to imply that those timber-covered tracts not included in these reserves might be used for destructive cultivation (koomree or dulleran); but as Government have disapproved generally of this mode of cultivation, it would not be legitimate to infer that the reserve scheme was intended to encourage in any way the continuance of a system most injurious to any moderately-wooded country, destructive of valuable property, and tending, by the production of a wretched kind of food, to depress the physical energies and social well-being of the Indian labourer.

"Government, in the resolution quoted, intimated that these reserves should be well defined, and they are so in the village maps, but nowhere else. The lines and demarcations between forest land reserved and non-reserved are there neatly painted; we see triangles and polygons are green, these are the proposed reserves, but we do not find corresponding lines and figures in nature in the middle of a wooded tract. The scheme, if it were practicable, would be bad, as opening a door to waste as well as fraud; but it is impracticable. This impracticability of distinguishing such imaginative figures in nature is one of the principal reasons for advocating the expediency of buying up the forest rights of the numerous inamdars throughout the country, as their estates are so intricately mixed up with the general forest land of the country as to render proper supervision difficult, while it gives the people opportunities of plundering Government forests under the protection of inamdars' passes, which are easily obtained for a trifle paid to their agents.

"Under all the circumstances now adverted to, along with our diminishing forest resources, it will be acknowledged that it is not *some* forest land that should be under conservation, but all forest land, as long as it is entitled to that character by being covered with trees, whatever destination such land may ultimately have.

"The Government of France (perhaps the most enlightened in matters of forest legislation), so far from leaving out of protection for undefined purposes any part of their own forests, extend their regulations to the forests of all private proprietors, being convinced of the truth that private interests are often in opposition to the general well-being of the country, and this has been well exemplified in the past history of the teak forests in the Rutnagherry zilla.

"Buying up the forest rights of private proprietors is, however, preferable to imitating the example of France. We learn from it, however, that forest legislation should rest upon a broader and more general basis than the present and often short-sighted convenience of an ignorant peasantry, and that along with public convenience must be united the interests of posterity and the conservation of those climatal influences on which agriculture depends.

"Even landed proprietors in Europe, so far from knowing what was advantageous to the state in the matter of forests, were often ignorant of what was advantageous to themselves.

"In France the Legislature of 1791, urged by the importunities of landed proprietors, reconsidered the forest regulations framed under Louis XIV. in

1669, and it was decreed that henceforth every citizen should have absolute liberty to cut down his own forests, under the impression that every proprietor was the best judge of the kind of culture which suited his circumstances, and that a man's own interests would be his best guide.

"Experience, however, that toutchstone of all human enterprises, proved that the Legislature was wrong. The hope of increasing their income hurried many proprietors into cutting down their woods without consulting the nature and posdition of the ground, and the forests on the slopes of the mountains did not escape the legalised devastation; the most of them were cruelly punished for their improvidence. The light layer of earth which covered the ground was carried away by the winds and rains, and they saw their property, otherwise productive, struck all of a sudden with eternal barrenness. Prohibitions were soon again introduced (April, 1803) and are those still in force, and they are found to be for the interests of all, even of those upon whom they are imposed.

"To return to our India forests. The smaller tracts of jungle, which it has been suggested should be relieved from conservation because they sub-divided too much the attention of the Forest Department, should be regarded from a more general point of view, not only as making up a considerable aggregate, and under proper management affording materials to the ryots, but as having a value of another kind not appreciable to the senses.

"In conclusion, therefore, as far as our first rule is concerned, there ought to be under the direct control of the State as much forest land as is obtainable without the invasion of private rights, and without throwing any restriction in the way of the extension of legitimate cultivation.

"With regard to the 2nd rule, what practical measures are to be adopted to prevent as much as possible the supplies of forest produce from failing at a future time, they are as follows:—

1st. By conserving, as has already been said, every patch of forest in the country.

2nd. By cutting down old hollow and mature trees only, sparing, of course, all the younger trees.

3rd. By a total suppression of dullee or destructive cultivation.

4th. By putting a stop to the pernicious practice of setting fire to the brushwood on the slopes of the hills and to the jungle generally."

In a speech made by Mr. Grant Duff, Under Secretary of State for India, on the financial position of India, we find the following passage relative to the destruction of forests:—

"Forests always seemed inexhaustible until they began to be exhausted. When history came to number up the good deeds which Britain had done for

India we should not forget to record among them that, not an hour too soon, but yet not too late, she called in European science to check the destruction of the forests. No one who had not looked into this subject had the faintest idea how terrible were the effects over wide regions of the globe of carelessness in keeping up a proper proportion of trees. Let any one to whom this whole matter was new turn to the remarkable work of the American Minister at Florence, and he would shudder at the dangers which we had only just escaped. If our predecessors in India had known what we know, much of the enormous expense that we are now being put to with regard to irrigation would have been quite unnecessary. But the mistakes of former days were past praying for, and we could now only rejoice that free course was being given to Dr. Brandis and his subordinates, that the conservation of the forests had been recognised as a great state necessity, that a Regular Forest Department had been inaugurated which would take to India the science of France and Germany, and that the good example of forest conservation set in British territory was beginning to spread into some of the native states. The forest revenue was derived from various sources, chiefly from the sale of timber, but also from a system of seigniorage, or licence to cut, which would, however, disappear when the amended arrangements for forest organization were complete.

The above observations were made the text for an article in the *Times*, from which the following is extracted:—

"In the able statement which Mr. Grant Duff made of the financial condition of our "Great Vassal empire of Asia," he touched upon a subject of vital importance to many countries besides our East Indian possessions. He alluded to the efforts made by Her Majesty's Government in India for the preservation and reproduction of forest trees. There is perhaps no subject better entitled to the attention of practical politicians, yet no subject more heedlessly abandoned to the speculation of the economical theorists, no subject on which the rules of the commonest foresight have been more utterly disregarded. There is nothing, perhaps, on which men in many countries evince greater improvidence than the destruction of woods; yet there is hardly a cause apparently trifling which is attended with more calamitous effects.

"The mere want of firewood and timber is not, however, the most grievous evil with which those southern countries are afflicted. 'No one who has not looked into this subject,' observed the *Under Secretary for India*, 'can have the faintest idea how terrible are the effects over wide regions of the globe of carelessness in keeping up a proper proportion of trees.' Between man and climate there is incessant war. Wherever man fails to conquer he and his work perish. It may be said of the sun as of water, of fire and all other gifts of *God*, that they are useful servants but bad masters. The field the sun's light ought to fertilize withers under its beams, the meadow which moisture should soften is flooded and swamped. It is to the neglect of man to supplement nature that we owe the loss of some of the most glorious tracts of Asia and Africa. It is the same lack of energy and foresight that is turning many of the fairest lands of Southern Europe into wastes.

"The dread enemy of Spain, of Italy, and of India is drought. The most immediate cause of drought is, or has been, the disappearance of wood. It is necessary to replant the trees; the growth of the trees must depend on the aid of moisture. There is here an alteration of cause and effect, and the result can only be expected at the end of many years' perseverance and sacrifice. Allusion was made in the House of Commons to Mr. Marsh's Essay on 'Physical Geography, as Modified by Human Action.' But that work only followed in the track of numerous interesting publications, by which, especially in France, the effects of destruction of woods on the aspect of the country, on the temperature, and even on the healthiness of the climate, were diligently pointed out, and by which, after laying bare the evils, an appeal was made to all public and private energies to work out the cure. We hardly know, however, to what extent these excellent theories have met, even in France, with practical application. In Spain and Italy, where the power of government has been greatly undermined by long revolutionary periods, not only is the growth of new plantations nowhere considerable, but all efforts to enforce provident forest laws turn out almost entirely unavailing. Wherever you go—across the wind-swept plains of Castile, along the bleak Sierras of Tolevo or Guadarama, anywhere in the Spanish Peninsula away from the green zone of the Pyrenees, or in Italy along the slope of the Alps, or on the crest of the Apennines—you see the traces of recent devastation. Men yet in the prime of life point to the hill sides which they remember having seen beautifully mantled with wood in their early life, or they show you the few ilexes still scattered around on the dreary landscape, straggling on a blank surface which was once teeming with tens of thousands of similar trees. The exigencies of such niggardly husbandry as the Southern husbandman pursues grudge even an inch of ground for the growth of forest trees, and the hatred of all foliage as being the shelter of destructive birds, prompts an insane warfare against timber even where the alternative lies between harmless wood and bare rock. Even where plantation is attempted, or where nature herself puts forth spontaneous shoots, the little regard for private or public property, the total absence, or dilapidated condition of walls and fences, and the free right of pasture possessed or usurped by a lawless rural *proletariat*—a variety of social disorders—has a tendency to nip all vegetation in the bud. Were it not for the fruit of the chestnut or walnut, it is very questionable whether as much green shadow as would cover a man would be suffered to flourish in either Peninsula. The waters from the glaciers of Monte Rosa or of the Sierra Nevada do, indeed, insure inexhaustible fertility to broad patches of Lombard or Andalusian plain; but, throughout the length and breadth of the land, man's influence tends to turn the country into a dreary blank, to give the scorching sun, the nipping winds, the flooding showers full play, and to make as little of the beautiful soil and of the blissful climate with which Nature has endowed him, as sloth, improvidence, and want of taste and feeling could contrive.

"There is reason to hope that matters bear a more cheerful aspect in our East India dominions. The first impulse in that direction was given by the great warrior who gathered his first laurels in those Eastern regions in the earliest years of the present century, and whose talents for practical usefulness in civil government were fully on a par with his great abilities as a military commander. The old works of irrigation by which vasts tracts of that Asiatic Peninsula were fertilized were extended and improved by a people who never disdained to look for instructions to the achievements of its neighbours; but, while the study of Lombard and Piedmontese canals, and the Moorish hydraulic works of Valencia and Murcia availed us in our management of those of India, we perceived how imperfect the influence even of the most copious irrigation must be unless aided by a corresponding development of vegetation, and we endeavoured to implant among our Indian subjects that veneration for trees the absence of which is so fatal to the general prosperity of Italy, Spain, and of her South European communities."

(To be continued.)

M. G. VILLE'S SYSTEM OF CHEMICAL MANURES.

By M. Le Chevalier Mussa,
Professor of Agronomy in the Institute of Messina.

Seven years have elapsed since M. G. Ville's system of chemical manures was introduced into the culture of the sugar cane in the French colonies, and the benefits derived from it have become more and more apparent. The average crop of canes now obtained is equal to the largest crops produced under the old system of manuring, the richness of the juice has increased, and some of the evils of the old system have been prevented. The testimony of the planters in the French colonies to these facts is unanimous, and the demand for chemical manures from the mother country has yearly increased, and has necessitated the starting of many new factories to supply the demand.

The truth of these statements is easily ascertained, and planters who have not yet benefited by M. Ville's system of manuring are advised to give it their serious consideration. The first question that presents itself is—What is M. Ville's system of chemical manuring, and wherein does it differ from other systems which have been long practised?

So long as the analytical method of investigation was exclusively practised, no decisive results were obtained; but when the synthetical method was adopted, the effects were marked. This latter has been practised by science in two different ways: in the one, plants have been reared in artificial soil with the addition of the elements of the plants in the form of chemical salts; in the other, plants have been reared in a solution of similar salts. The last led to the conclusion that the elements necessary to be supplied to the plants were nitrogen, phosphoric acid, potash, lime, sulphuric acid, oxide of iron, and magnesia, which are most active in the form of chemical salts. But the experiments with soil showed that cultivated soils rarely need sulphur, iron, or magnesia, as they usually contain sufficient. But on this point *savants* disagreed, until it was fully demonstrated by M. G. Ville. This was only one step in advance, but in further progress M. G. Ville has been equally successful.

If to secure the best development of the plant the cultivator had to supply in an assimilable form but four out of the fourteen constituent elements of the plant—viz., nitrogen, phosphoric acid, potash, and lime—the questions to be resolved were: What is the particular action of each? which is of the most importance to each kind of cultivated plant? what proportional quantity of each will form the best manure? and how should these quantities absolute and relative be changed for each kind of plant, for different soils, diverse climates, and various modes of culture?

M. G. Ville has solved this complicated problem in an admirable manner, and his conclusions have been more and more confirmed by practical experience. The method of formulas for each class of plants which he introduced is well calculated by its simplicity to facilitate the carrying out of his system by agriculturists.

The sugar cane has been the subject of M. Ville's particular inquiries, and aided by direct experiments, practised by planters in the Antilles, he has at length fixed on a choice formula, which is now extensively used in those colonies with great advantage to the planters. It is as follows:—

	Per hectare.		Per acre.
Superphosphate of lime	600 kil.	about	534 lbs.
Nitrate of potash..........	200 ,,	,,	178 ,,
Sulphate of lime..........	400 ,,	,,	356 ,,
	1200 ,,	,,	1068 ,,

Pursuing his inquiries, M. Ville has succeeded in reducing this quantity to 800 kilogrammes per hectare (712 lbs. per acre), by substituting precipitated phosphate for superphosphate, without altering the richness of the manure.

One of the characteristics of M. G. Ville's system, the ascertaining by experiment the *dominant* of the several agents, *i.e.*, that which acts more than the others on any given plant, has already been noted in this magazine. Thus, whilst the *dominant* of cereals is nitrogen, that of the sugar cane is phosphoric acid.

It may be remarked, that though the formulas of M. G. Ville may appear to comprise but four agents of fertility, still, in the form in which they are prescribed, they contain both sulphuric acid and magnesia. Thus his system is in perfect accord with all that the most exigeant science could claim.

In conclusion it must be observed, that in M. Ville's system, chemical manures are prepared only according to his various formulas—an important point in practice.

This system has in its favour not only the entire assent of scientific inquiry, but the full confirmation of practice, particularly so with regard to the culture of the cane. Therefore, those planters who have not yet availed themselves of the advantages of M. Ville's system of manures, would do well to give it a trial.

THE ELEPHANT CANE IN GUADELOUPE.

At a late meeting of the Chamber of Agriculture of Basse Terre, (Guadeloupe), a letter from the Governor called attention to a communication which the administration had received from M. Bavay, relative to a caterpillar found in the canes brought from Cochin China. M. Bavay then informed the Chamber that, since his communication with the Government, he had received from the Chamber of Agriculture of Point à Pitre some of the chrysalides of the insect found in the miâ-voy cane; that these chrysalides are produced from caterpillars which, unlike the borer, do not feed on the substance of the cane, but are deposited in the terminal buds, and that the butterfly of this insect does not in size resemble the butterfly of the borer.

M. de Touchimbert, who first gave the alarm of the presence of the borer in Guadeloupe, had not observed anything new relative to the insect, the presence of which he had discovered in the miâ-voy canes on his plantation, but he stated, that on the mere supposition that this insect might be the borer, the inhabitants of Trois Rivières who had introduced the elephant cane into their plantations had entirely destroyed it, and that they had had less difficulty in deciding to do so, because experience had convinced them that this cane (miâ-voy or elephant) did not possess any quality to jnstify its preference over other species cultivated in the colony, and that in one respect it was desirable that its cultivation should be discontinued, because of the difficulty of ensuring its pressure by the mill, on account of the brittleness of its fibre, shown by the breaking of the cane immediately on being placed between the rollers, so that to make it pass through it has to be held quite to the end, whilst the megass which it produces is broken into small pieces and retains considerably more juice than the megass of ordinary cane. In short, M. de Touchimbert thought that all things considered, the cultivation of the elephant cane should be given up.

The Chamber adopting this opinion, concluded that in the published account of their proceedings the inhabitants should be warned against the introduction of the miâ-voy cane into their plantations, and that those who were already growing it should be invited to follow the example of the planters of Trois Rivières and destroy it.

SALES OF CONCRETE REPORTED IN ENGLAND, FROM FEBRUARY TO SEPTEMBER, 1872.

Date of Sale.	Packages.	Country.	Port.	Price, per Cwt.	In Bond or Duty Paid.	Purchasers.
Feb. 1	650 Bags	Peru	Liverpool	23/-	In Bond	Liverpool Refiners.
,, 12	2517 Bales	Ilo Ilo	,,	24/6	,,	,, ,,
,, 12	4 Barrels	,, ,,	,,	24/6	,,	,, ,,
March 12	55 Tierces	Montserrat	,,	25/- to 26/-	Duty paid	,, ,,
April 8	452 Tierces	Trinidad	London	23/9	In Bond	Bristol Refiners.
,, 29	260 Bags and Boxes	Colon	Liverpool	20/-	,,	Liverpool Refiners.
May 1	450 Tierces	Porto Rico	London	24/-	,,	Plymouth Refiners.
,, 2	275 Bags	Peru	Liverpool	22/6	,,	Liverpool Refiners.
,, 16	200 Tons	British Honduras	,,	25/3	,,	,, ,,
,, 16	260 Tierces and Barrels	,, ,,	,,	25/4½	,,	,, ,,
,, 25	150 Hogsheads	Antigua	,,	25/6	,,	,, ,,
,, 25	193 Barrels	,,	,,	25/6	,,	,, ,,
,, 28	280 Tierces	Trinidad	London	26/-	,,	London Refiners.
,, 28	533 Bags	Central America	,,	21/- to 24/-	,,	London Refiners & Grocers.
June 4	510 Tierces	Trinidad	,,	26/6	,,	London Refiners.
,, 6	4700 Bags	Peru	Liverpool	23/-	,,	Liverpool Refiners.
,, 7	400 Bags	,,	,,	23/6	,,	,, ,,
,, 11	51 Bags	Central America	London	24/- to 26/-	,,	London Grocer.
,, 15	519 Bags	Peru	Liverpool	23/6	,,	Manchester Refiners.
,, 15	2000 Bags	,,	,,	24/6	,,	Liverpool Refiners.
,, 25	245 Bags	Central America	London	22/-	,,	London Grocers.
July 2	53 Bags	Carthagena	London	21/6	,,	London Grocers.
,, 2	600 Bags	Peru	Liverpool	26/- to 27/-	Duty paid	Liverpool Refiners.
,, 5	89 Bags	Central America	,,	22/6 to 23/6	In Bond	London Grocers.

July	6	624 Bags	Peru	Liverpool	22/3	In Bond	Manchester Refiners.
"	10	51 Tierces	Montserrat	"	28/6	Duty paid	Manchester Refiners.
"	12	1018 Bags	Natal	London	22/9 to 24/6	In Bond	London & other Refiners.
"	19	118 Bags	Central America	"	23/6	"	Brewers.
"	22	306 Hogsheads	Montserrat	Liverpool	28/6 to 34/6	Duty paid	Liverpool Refiners.
"	22	690 Tierces & Barrels					
"	22	187 Hogsheads	Antigua	"	25/-	In Bond	" "
"	22	272 Barrels					
"	26	557 Hogsheads	Trinidad	"	24/3	"	" "
"	28	250 Bags	Peru	"	21/6	"	" "
"	30	100 Hogsheads	Antigua	"	24/9	"	Manchester Refiners.
"	30	157 Barrels					
"	30	26 Hogsheads	"	"	23/-	"	" "
Aug.	15	170 Bags	Peru	"	21/9	"	Liverpool Refiners.
"	15	1500 Bags	Maccio	"	23/6	"	" "
"	16	200 Bags	Peru	"	21/-	"	Manchester Refiners.
"	20	320 Tierces	Honduras	"	28/6 to 29/-	Duty paid	" "
"	20	100 Hogsheads	Antigua	"	24/9	In Bond	" "
"	20	236 Barrels					
"	23	209 Bags	Peru	"	21/-	"	Liverpool Refiners.
"	26	345 Tierces	Trinidad	"	24/-	"	" "
"	27	100 Hogsheads & Trcs.	Jamaica	"	29/6	Duty paid	London Refiners.
Sept.	2	230 Bags	Peru	"	22/3	In Bond	Liverpool Refiners.
"	7	2205 Bags	"	"	20/-	"	" "
"	17	110 Bags	"	"	22/6	"	" "
"		355 Tierces	Porto Rico	London	21/-	"	London Refiners.
"	24	207 Tierces	Hondurus	"	23/6	"	" "

FRENCH REFINERS AND THE DRAWBACK.

(From Baruchson & Co.'s Beet-root Sugar Circular.)

Our refiners have hitherto generally confined their purchases for delivery to sugars between numbers 7 and 9 Customs standard, (but in reality between 9 and 12 *type de Paris*), for which they paid one or two francs more per 100 kilogrs. than for sugars of a higher colour, and such contracts have not only been made with our manufacturers, but also in Belgium, where, if we are rightly informed, they have many facilities under different fiscal regulations *to arrange* sugars to be admitted in this country as between 7 and 9; such sugars generally analyse from 88° to 90°, and often even higher. Our refiners will thus receive a drawback or quittance on 100 kilogrs. of this sugar in exporting 80 kilogrs. of refined, leaving a surplus of 10 kilogrs. for home use, which at the present duty of more than 2½d. per lb. will give them a bonus of about 2s. per cwt., and the English refiner will have to contend against this and several other advantages enjoyed here.

It would be highly desirable just now, when a new treaty is about being concluded between Great Britain and this country, that the modification and proper interpretation of the Sugar Convention, of 1864, should be one of the required conditions, and that the advisers of our Government in fiscal matters should make it their duty to point out the loss which the revenue sustains by the above system, as well as the injustice thereby inflicted on the tax-paying population of this country, and the generally unsatisfactory application of the Convention in regard to the refiners of the United Kingdom.

Correspondence.

Masson Works, Litchurch,
Derby, October 16th, 1872.

To the Editor of "The Sugar Cane."

Sir,

Referring to the report of Commissioners from Antigua, appointed to enquire into the working of the central sugar factories in Martinique and Guadeloupe, see *Sugar Cane*, No. 39, folio 517; it is stated therein that the machinery for Dillon estate was supplied by Messrs. Lecointe Freres et Vilette; leading the reader to suppose that they supplied the whole, the fact is, we made the grinding machinery, (*i. e.*,) engine, gearing, cane mill, and cane megass carriers for the usine Dillon, and Messrs. Lecointe Freres et Vilette, the remainder of the apparatus.

Yours truly,

George Fletcher & Co.

MAURITIUS.

(From Licht's Monthly Circular.)

EXPORTS FROM 1ST AUGUST TO 25TH JULY.

	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
To England..........	47,000	.. 22,600	.. 38,100
,, France	13,500	.. 6,200	.. 11,100
,, Australia	29,600	.. 38,200	.. 46,200
,, Bombay..........	24,500	.. 16,700	.. 29,500
,, New Zealand......	3,200	.. 3,500	.. 3,600
,, Cape of Good Hope..	1,200	.. 1,900	.. 2,300
,, Other Ports	6,000	.. 900	.. 1,200
Total..........	125,000	90,000	132,000

HAVANA AND MATANZAS.

EXPORTS FROM THE 1ST OF JANUARY TO THE 5TH OF SEPTEMBER.

	1872. Tons.	1871. Tons.	1870. Tons.
To United States	184,496	..149,962	..158,603
,, Great Britain	137,977	.. 61,486	..167,642
,, France	21,617	.. 10,707	.. 43,960
,, Spain........................	34,981	.. 43,570	.. 56,415
,, Northern Europe............	12,102	.. 7,955	.. 9,925
,, Southern Europe............	960	.. 547	.. 3,410
,, Other Countries	4,995	.. 2,905	.. 7,663
Total......	397,128	277,132	447,618
Stocks in Havana and Matanzas ..	60,062	.. 66,915	.. 58,854

Stocks of Sugar in the Chief Markets of the World on the 1st September for Three Years, in thousands of tons, to the nearest thousand.

	1872.	1871.	1870.
Great Britain	158	166	181
France	45	30	34
Germany (Zollverein)	3	2	2
Holland	37	38	39
Six other Ports	6	5	6
Total in Europe	248	241	262
United States	121	134	141
Havana and Matanzas	60	67	58
Total	429	442	461

Consumption of Sugar in Europe and the United States, for Three Years ending 31st August, in thousands of tons.

	1872.	1871.	1870.
Great Britain	689	689	676
France	249	252	318
Germany (Zollverein)	212	212	208
Holland	26	25	31
Six other Countries	84	115	109
Total in Europe	1,260	1,293	1,342
United States	561	507	470
Total	1,821	1,800	1,812

Estimated Crop of Beet Root Sugar on the Continent of Europe, for the ensuing Season, compared with that of the three previous Seasons.

(From Licht's Monthly Circular.)

	1872-73.	1871-72.	1870-71.	1869-70.
	Tons.	Tons.	Tons.	Tons.
France	335,000	335,351	289,084	289,324
Germany (Zollverein)	240,000	189,166	262,986	217,192
Austro-Hungary	170,000	161,526	182,280	151,354
Russia and Poland	125,000	90,000	135,000	132,500
Belgium	75,000	72,236	55,739	43,552
Holland and other Countries	35,000	25,000	17,500	12,500
Total	980,000	873,279	942,589	846,422

SUGAR STATISTICS—GREAT BRITAIN.

To 19th October, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	33	3	3	29	68	53	83	12	13	57	165	195	62	9	11	34	116	168
British East India	8	1	..	..	8	6	15	5	..	..	20	9	10	7	..	..	18	20
Mauritius	4	1	..	..	4	4	15	5	13	7	40	16	13	4	14	10	42	16
Cuba	6	2	2	23	34	21	8	14	23	67	112	52	5	12	21	50	88	43
Porto Rico, &c. ..	3	7	..	3	13	5	5	19	1	8	33	25	3	14	1	6	24	25
Manilla & Java ..	12	4	..	3	19	24	23	12	2	12	49	39	23	18	2	9	52	55
Brazil	3	13	1	6	23	18	8	45	9	21	84	55	6	40	9	20	75	52
Beetroot, &c.	1	..	..	..	2	3	16	9	4	32	60	111	20	11	6	36	72	122
Total, 1872 ..	71	31	6	61	172	134	173	120	65	204	562	501	143	115	64	165	486	500
Total, 1871 ..	63	26	5	41	38 increase		170	98	51	182	61 increase		176	105	51	169	14 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

The depression which has ruled in our markets during the greater part of the month has given place to some degree of activity during the past week, and considerable business has been done at rather steadier prices, without any actual advance.

Stocks in the four ports show a decrease from last month of 15,000 tons, but as compared with last year at this date, an increase of 38,000 tons; they are now only 12,000 tons below those of the corresponding period of 1870, when prices were about 1s. per cwt. lower than present rates. Deliveries have been more satisfactory than for some time past. Imports have not fallen off during the month to the same extent as is customary at this season, and have reached 61,000 tons above those of last year to the same date.

Prices of the better grades of raw sugars are about the same as last month, No. 12 Havana afloat is quoted at 28s. to 28s. 3d., No. 12 Mauritius at 28s. 6d., and Cuba Muscovado 25s. 6d. to 26s. In lower classes of goods, prices have not been maintained; middling to good brown Bahias are worth 20s. to 21s., and good to fine brown Pernambucos 21s. 6d. to 22s. 6d. in bond. The average duty paid price of refining qualities of British West India is 28s. 6d. per cwt. Refined goods are in better demand, at about previous rates. Common refined lump sugar is quoted at 39s. to 39s. 6d. per cwt.

New season's beet sugars are beginning to arrive, and there is no doubt that our markets will soon be well supplied with them. The latest accounts of the crops do not vary materially from previous reports. It is now pretty fully established that the root crop is smaller than was anticipated, but in many parts the percentage of yield in sugar on the root is rather above that of last year, in France especially. M. Licht has again reduced his estimate of the continental production, though the figure yet stands at 980,000 tons, which is considerably larger than that of any previous year.

THE

SUGAR CANE.

No. 41. DECEMBER 2, 1872. Vol. IV.

☞ The writers alone are responsible for their statements.

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THE SUGAR QUESTION.

It will be remembered that the Conference of Delegates from the four contracting Powers, parties to the Convention of 1864, met in London last August, and adjourned without fixing any date for re-assembling, and that the results of its deliberations were not made public. This reticence on the part of the Conference and of the Governments represented, has naturally caused rumours of various kinds, relative to the action to be taken, as it could scarcely be credited that the arduous and prolonged labours of the British refiners which had led to the acceptance of the principle of refining in bond, by the majority of those interested, in three out of the four contracting countries, and to the assembling of the Conference to consider this and other cognate questions, could have resulted in any "lame and impotent conclusion." Thus, we find it has been currently reported in the Dutch papers, that the system of refining in bond was definitely rejected on account of the difficulties attendant on carrying it out; but that the meeting of the Conference was "not wholly unfertile," inasmuch as it had decided that the legal return of raw sugars of the third and fourth classes was to be increased from 80 to 82 and 67 to 70 respectively; and that those sugars of which the strength did not correspond to the colour should be assessed according to their saccharine richness as determined by chemical analysis; further, that the estimated yield of sugar from the beet juice (in Belgium) should be increased from 1500 to 1600 grammes per hectolitre, and that the correlation of duties and drawbacks should be established in France before the 1st January, 1873.

There is reason to believe that so far as related to the rejection of the proposition for refining in bond, this account was only too true, but for the rest, there was little or no foundation, beyond the fact that the *projet de loi*, which will shortly be brought before the French Assembly, contains some provisions relative to the assessment of sugars by analysis in certain exceptional cases.

It has also been reported, on what seemed good authority, that a Commission was sitting in France, considering the various processes of analysis, but this appears to have had its origin merely in the fact, that the Minister of Agriculture and Commerce had appointed a Commission to examine the various types of sugar which had been prepared in accordance with the provisions of the Convention of 1864, and to revise these types if needful. This Commission, which consisted of eighteen members, five of whom were Government officials, four *fabricants*, five refiners, two sugar merchants, and two brokers, met on the 7th November, and, we are told, finished its labours in a single sitting. It is said that the French Government, which was strongly represented in the Commission, was anxious that the colour of the types should be reduced, particularly of those held by the Excise for the assessment of the duties on indigenous beet sugar, but the Commission thought, that in the present state of legislation on the subject, it would be unwise thus suddenly to unsettle the sugar trade, and decided that the types used in the home beet sugar manufacture should not be meddled with, but that what are called the "Antilles" types needed some adjustment, several of them having become slightly altered. The *Sucrerie Indigène* asserts that whatever other subjects may have been discussed, the question of the substitution of classification by saccharimetry for that by colour did not in any way come before the Commission for consideration.

Though in some respects the meeting of the London Conference may have been entirely without results, it is much to be regretted that no official report of its proceedings was published at the close of its sittings; as however unsatisfactory its conclusions with reference to the principal question considered, the knowledge of the facts, although disappointing, would have been preferable to the uncertainty which has since prevailed.

NEW METHOD FOR THE ESTIMATION OF GLUCOSE.

By M. C. Knapp.

(From the "Journal des Fabricants de Sucre.")

Professor Liebig, in his researches on fermentation, announced that in a mixture of liquid yeast with cane sugar the addition of hydrocyanic acid did not prevent the transformation of the cane into fruit sugar, by the organic substance contained in the yeast; and that when this mixture was saturated with oxide of mercury, and carried to the boiling point, there was generally obtained by the addition of soda solution a metallic precipitate of mercury, which could not be obtained from alkaline cyanide of mercury under similar circumstances, by the addition of cane sugar.

The experiment indicated therefore, that an alkaline solution of cyanide of mercury is completely reduced to a state of metallic mercury by grape sugar. In consequence, I have tried to utilize this reaction in the estimation of grape sugar by the following method:—

To 10 grammes of pure dry cyanide of mercury dissolved in water, 100 cubic centimetres of soda solution of a density of 1·145 were added, and the whole diluted to 1000 cubic centimetres.

Some grape sugar, or glucose of commerce, was first dried at 100° Cent. (212° Faht.), then by prolonged boiling a saturated solution of it in absolute alcohol was obtained, on cooling which, crystals separated which were employed as a standard.

By a series of experiments it was proved that 400 milligrammes of cyanide of mercury might be reduced by 100 milligrammes of grape sugar in anhydrous solution carried to the boiling point.

In estimation, the method was conducted exactly in the same way as the Fehling process. Forty cubic centimetres of a solution of cyanide of mercury were placed in a porcelain capsule and raised to the boiling point, then a solution of about 50 per cent. of sugar was allowed to fall into it until all the mercury became precipitated. The per centage of glucose is calculated from the quantity of saccharine solution required.

When a solution of sugar is thrown into a boiling alkaline solution of cyanide of mercury, the mixture becomes turbid immediately, but clears itself towards the end of the operation, and is then of a yellow colour.

To note how the operation is progressing, from time to time the liquid is dropped on a bit of the finest Swedish filter paper, placed upon a glass and wetted with a little slightly concentrated sulphite of ammonium. As long as there is still cyanide of mercury in the solution, the paper takes a brown stain, and the operation is shown to be finished when this brown stain can no longer be seen. The termination is still more closely perceived by placing a little of the solution on a strip of Swedish paper, and then dropping upon it sulphide of ammonium for nearly half a minute.

At first the stain is wholly brown, but towards the end of the operation there is only formed a clear brown ring round the edge, of which it is only possible to be sure of the existence by holding the paper up to the light of a bright window, so as to see through it.

At last, the wetted paper remains unchanged by the fumes of the sulphide of ammonium, and with a little practice it is easy to estimate the glucose to one-tenth of a cubic centimetre in a solution of 50 per cent. of sugar.

If at the end the stain is allowed to dry, there will still appear a clear brown ring of sulphide of mercury, as there will always be in the liquid a trace too much either of grape sugar or of the cyanide of mercury, which can only be dispelled by an excess of either one or the other. The exactitude of the estimate is not however affected when the stains are examined whilst wet.

A great number of deteriorations of sugar, made in the course of of M. Liebig's researches on fermentation, with a view of comparison, have proved, that though this method cannot claim any greater precision than that of Fehling, yet that it is quite as exact. The new method possesses the advantage that it requires less time to carry it out, and that foreign matters, such as many of the alkaloids which change the colour of protoxide of copper, have no influence on that of cyanide of mercury.

Another advantage, and perhaps the principal one, of the new process, is the great facility with which the reagent can be prepared and perfectly preserved.

REAGENTS FOR CLARIFYING SUGAR SOLUTIONS.

By O. Wachsmuth, Chemist, Anvers.

(*From La Sucrerie Belge.*)

It is sometimes difficult to obtain perfectly decoloured solutions of very brown sugars for polariscopic analysis. The ordinary means of clarifying, animal charcoal and subacetate of lead, are not always quite efficient. The first gives a yellow tint to the liquid, and the second renders the solution untransparent. Experiments made with other substances such as tannin, hydrated oxide of alumina, sulphate of alumina, in combination with liquid subacetate of lead, although having produced some valuable results, have not yet led to the discovery of an absolute decolorant.

As in the clarification of turbid liquids, substances which act by a kind of envelopment are used, and basic acetate of lead, for its slightly astringent action, by which it separates colouring substances from organic matters is used in preference; my endeavour was to find some substance whose enveloping action would unite with that of the basic acetate of lead.

After having experimented with divers acids and organic substances, I am now using with success the following process, as simple as it is satisfactory.

The two reagents, which in combination produce the desired effect, are tannin and liquid subacetate of lead, united in such proportions that they are neutralized and disappear without difficulty in the filtered solution.

The following is the formula for the preparation of the tannin:—

20 grammes Tannin,
30 ,, (37 c. c.) Alcohol,
50 ,, Distilled Water.
Dissolve and filter.

The solution of tannin formed is thus used:—

After the solution of the sample of sugar in sufficient quantity of water, according to Ventzke, 13·05 grammes to 50 c. c., there is added, according to the depth of colour of the sugar 8, 16, 24, 32, or 40 drops of solution of basic acetate of lead cold, the flask is then shaken and 16, 32, 48, 64, or 80 drops of the tannic liquid added, that is to say, double the quantity of the subacetate of lead, care being taken to shake the flask after the addition of each eight drops. The flask is then filled with water up to the proper mark and forcibly shaken; the liquid is then filtered, &c. A very considerable precipitate of tannate of lead being thus formed, the process possesses the desired action in a very high degree, and ordinarily by the use of 8 to 16 drops of the acetate of lead and 16 to 32 drops of the tannic liquid, a solution is obtained perfectly fitted for optical assay. In sugars of the lowest products and of the darkest colour I have never had to use more than 40 and 80 drops respectively; for molasses I have used double the quantity of the two reagents.

It is not needful to observe that the precipitate of tannate of lead occupies a certain volume in the sugar solution and some allowance for this should be made in reading the scale of the polariscope. The experiments I have made, have led to the conclusion that one-tenth of a degree should be deducted for each eight drops of acetate of lead and 16 drops of tannic liquid used, or one-half per cent. for 40 drops of the former and 80 drops of the latter. I must observe that in making these experiments, I have used Ventzke's instrument, in the solution adapted to which 50 c. c. contains 13·05 grammes of sugar. For Duboscq's or Wild's instrument the proportions would be different.

It has often been stated that the tannin of commerce will alone deflect the ray of polarized light, but my experiments have not led to this conclusion.

By my method the tannin is perfectly eliminated and is precipitated with the lead, and the filtered saccharine solution shows scarcely any reaction with salts of iron (for tannin), nor with hydro-sulphuric acid (for lead).

THE SUGAR QUESTION IN FRANCE.

(From the Journal des Fabricants de Sucre.)

A Memorial prepared for the Society of Agriculturists of France, by M. Emile Vion, sugar manufacturer, Lœuilly, Vice-President of the Central Committee, and member of the General Council of la Somme.

Gentlemen,

Up to the present time the *cane* has been the sugar plant *par excellence.* Imported from India to Egypt at the beginning of the Christian era, it gradually extended into many countries in the south of Europe, where it is at present but little cultivated. After the discovery of America it was introduced into the Antilles, of which it long constituted the chief resource.

During some centuries, sugar, the costly product of tropical agriculture, paying duty as an object of luxury, was not an article of general consumption, but it formed a medium of exchange for the commerce of the two worlds, and supplied the metropolitan refining industry.

The blockade of the ports during the first empire having shut out the produce of the cane from France and part of the continent of Europe, a substitute was sought from our indigenous plants, and found in the beet root.

Tried with varying success, and with persistence worthy of its future, the beet root has taken its place in our cultivated crops, and given birth to a great national industry. Thus the interests of marine commerce and refining, which long ruled over the sugar question, have fallen to the second rank, and given the first place to our agricultural production and indigenous manufacture. Such is now the actual state of the question to which our laws and customs reconcile themselves with difficulty.

This is not the aspect in which it is regarded in England, where, as there is no indigenous manufacture, the refining interest is what is chiefly considered.

Other neighbouring nations who cultivate the beet as we do, studiously endeavour to increase its culture, and with this end encourage the erection of numerous sugar factories. The larger countries, like Germany and Austria, jealously reserve their national markets, and strive to increase the consumption by light duties. The smaller, such as Belgium, seek rather to encourage the export of their products, and do not hesitate to lay a heavy duty on home consumption, that it may act in some degree as a bounty on export.

The indigenous sugar manufacture tends to agricultural progress, it attaches the workmen to their native districts, and in no small degree promotes provincial and rural prosperity.

These truths are generally admitted except in France, where they are ignored by our rulers, to whatever party or school of political economy they belong, and to the public generally the sugar question is simply a mystery; but the Society of Agriculturists of France, now recognizing a kindred interest in the sugar culture, has opened its tribune for the popularizing of the subject.

There are excellent reasons why the products of one of our principal industries should be exempt from duty. Taxes imposed on coal, on iron, on textile fabrics, on glass, porcelain, &c., would certainly be mischievous; burdensome to the consumer, and injurious to the producer. Why should any other view be taken when sugar is considered. Is it because sugar, like wine, is an agricultural product? Then we need not wonder at the amount of manual labour which abandons agriculture for manufacturing industry, and leaves the country for the towns.

Sugar is a wholesome article of food, of regular and daily consumption in the north of France, and its price only prevents its use by the most humble, it is therefore unwise to raise its price by duties, when there is such complaint of the natural increase in price of food generally.

In Belgium, in Prussia, and in Austria, the agricultural has made common cause with the sugar interest, and thus assured its triumph. Why should different branches of agriculture oppose each other in our country, and thus facilitate their being overcome singly?

Sugar culture is not confined to the rich province where it was commenced; it advances gradually but with constant and certain steps towards other regions where it is not even looked for, and, thanks to the facility with which it can accommodate itself to circumstances, no one can say where it will stop.

Besides, we must not suppose that those districts which it has not reached are unaffected by its prosperity. We have to seek abroad for a market for our wines, but a very slight improvement in the circumstances of our countrymen would do more for our vine-dressers than the best commercial treaties, and, though we have not the figures at hand, we can affirm that in our sugar departments the consumption of wine has increased ten-fold within twenty years.

Is it not the sugar culture that has so greatly increased the value of horses, cattle, sheep, and of the food which they require, of oils, oil-cakes, and the numerous other products, the consumption of which has been so augmented? We pass over the benefits conferred on our manufacturing industries, we speak now only of those received by agriculture.

Thus the interests of the indigenous sugar culture cannot be separated from those of agriculture in general; and we believe we may count on this great Assembly as its free representative, to give the sanction of its authority to this assertion.

In Prussia, the duty on sugar is nearly 25 francs per 100 kilogrms. (about 10s. per cwt.); in Austria, 23 francs (9s. 4d. per cwt.); in England, 15 francs (6s. per cwt.) Belgium, we repeat, seeks less to increase the home consumption than to favour exportation. She imposes 45 francs (18s. 4d. per cwt.) on the consumer, in order to give 5 francs to the exporting manufacturer.

Before the sad events from which we now suffer, and the weight of which will long be felt on our finances, our refined sugar was charged 50 francs, (20s. 3d. per cwt.) Sugar manufacturers were hoping to obtain a reduction of a tax, which raised the price of sugar nearly 70 per cent., but instead, an increase of three-tenths has been imposed, which has been accepted with patriotic resignation. But the projected budget, of 1873, now threatens us with a further increase of two-tenths, against which we protest and which we ask of you to help us definitely to repel. It is not our object to point out to the Government other industries it might tax; but for it to prey upon the sugar industry, because it makes no resistance, is neither able, just, nor moral.

The necessities of the culture have lately tended to increase the number and importance of the factories, a bad time to choose for decreasing the consumption of sugar. A duty of nearly 120 per cent. would increase the price so as to render it inaccessible by the working classes, and relegate sugar again into the list of luxuries. The Treasury itself will be not a little affected by the result. The manufacture will be dependent on foreign markets, always uncertain, and which may be closed at any critical time.

You are, therefore, solicited to express the opinion that the duties on sugar ought to be greatly reduced as soon as the finances of the country will permit, and that in the mean time they should not be further increased.

The duty on sugar is not only excessive, but the manner of its assessment is so irrational and mischievous, that the *fabricants* unanimously demand a reform.

It is specially important that at the time when the great increase in the duty has depressed the home markets, that the export should not be impeded.

If the duty was assessed on the produce (loaf or *poudre blanche,*) as it goes into consumption, it would neither discourage nor favour the export of sugars. It would, in this respect, be simply as though no duty existed, exported sugar would pay no duty, and there it would end. Unfortunately, it is the raw material on which the duty is imposed, or rather on the produce in course of manufacture. In the German States and in Russia, the duty is assessed on the root; in Holland, on the juice as it comes from the press; with us, on the raw sugar of all sorts and colours. It will be seen, at once, that the *fabricants* of Belgium, Holland, Germany, or Austria would not be able to export their sugar, if the duties paid on the root or the juice were not returned. The amount of this return or drawback can only be fixed by calculation of the yield of sugar from the raw material; and the needful data for an exact return being wanting, at least in practice, an average approximative yield has of necessity been taken. If the yield is taken too low the Treasury is injured, if too high, exportation is impossible. In this dilemma, each country leans to a low estimate, in order not to injure its export trade; thus an excess of duty is returned, which acts as a bounty; besides which, the dishonesty of the *fabricant*, or the connivance of the Customs' officer, may easily secure extra returns greatly in excess of the legal drawback.

In Belgium the duty is based on the calculation that a hectolitre of juice contains 1500 grammes of sugar for each degree of density, and we know that 1650 grammes at least are obtainable, equal to a bonus of a tenth part of the duty, which is 45 francs, or a bounty on export of 4½ francs (about 1s. 10d. per cwt.).

Thus wherever Belgian sugars come in competition with ours, whether in this country or in England, or elsewhere, they can be sold at 4½ francs (1s. 10d. per cwt.) less than ours, without any loss to the *fabricant*.

In Austria the excise is still more favourable to the manufacture. Instead of the total weight of all the beet roots being taken, it is estimated according to the manufacturing power of the factory. For this purpose an excise officer passes 24 to 48 hours in each factory at the opening of every season, and compares the quantity of roots rasped with the total weight of saleable material which is received; from this is calculated the daily working power of the factory, on which the assessment is based.

Practically this is equivalent to a benefit of one-third in the *fabricant's* favour, and obliges the customs which has only received

17 or 18 francs to return 23 francs 60 centimes on export, equivalent to a bounty of 6 to 7 francs, (say 2s. 6d. per cwt.)

In France, the duty being assessed on the raw sugar, there is no room for any drawback in favour of the *fabricant.* On the export of raw sugars, only the duty actually paid can be reclaimed. Yet, our foreign sugar trade is subject to a drawback and its consequences, as well as that of other countries, only it is not the principal industry, the factory, which profits, but an accessory, that is to say the refinery; and the drawback which is not only useless but hurtful to the sugar manufacture, has given an abnormal extension to the French refining industry.

Suppose a quintal of raw sugar is admitted to yield 80 kilogrs. of refined, and actually yields 88, the refiner is exempt from payment on 8 kilogrs., or one-tenth of the duty. The higher the duty the greater the bounty; with a duty of 50 francs the bounty would be 5 francs, with the present duty of 64 francs it would be 6·40 francs, and with the increase of two-tenths it would be nearly 7½ francs.

We do not say that the figure assumed (10 per cent.) represents the actual excess of yield. Refineries are not under excise supervision, and the refiners alone are able to enlighten us on this delicate point; but on the most moderate estimate the excess of yield is above 5 per cent., which is equivalent to a considerable bounty with the present duty, and would be equal to one-fifth more with the proposed increase.

It must not be supposed that this extra profit of the refiner benefits the *fabricant* by increasing the price of raw sugar, or the consumer, by diminishing the price of refined; perceptibly to influence the markets either way,—in default of interior competition, which is prevented by the production being in few hands;—foreign competition is needed, which this excess of yield gives our refiners the means of preventing, and enables them to exclude foreign refiners from the French market, both as buyers of raw and sellers of refined.

Thus foreign refined goods have never been able to obtain any stand in France, and except during the terrible time when Paris sustained a double siege, and the refineries were stopped for many months, the principal, and nearly the only means of exporting our sugars, has been through the refiners.

(To be continued.)

SLAVERY IN CUBA AND PORTO RICO.

The Spanish Abolition Society has presented the following address to the Senate in Madrid:—

The undersigned, president, vice-president, secretaries, and members of the *Sociedad Abolicionista Espanola*, approach the Senate respectfully, representing:—

1. That the definite law of abolition, promised in Moret's Preparatory Law, of 4th July, 1870, and which has also been repeatedly and solemnly promised by the Spanish Government, both before the Chambers and to foreign Cabinets, is not yet introduced or promulgated.

2. That Moret's Preparatory Law, of 1870, itself, in spite of professed urgency, has, in its principal articles, been in suspense till the publication in the *Gazette*, of August 19th, of the rules (*reglamento*) for its working.

3. That the *reglamento* referred to not only omits completely the grave matter consulted upon with the Captain-General of Cuba, respecting the fulfilment of Article 5 of the said Preparatory Law, but by the nature of many of its dispositions renders necessary another new *reglamento*, creating institutions respecting whose significance there cannot be the least doubt.

4. That the slaves who are free by right, through the insurgents having renounced dominion over them, and who, according to Article 5, of the law of 1870, cannot be held by the State, as it is forbidden by the State to possess slaves, are nevertheless retained in slavery, the State holding them by confiscation, but contrary to law.

5. That to the non-fulfilment of the Preparatory Law has been added the non-fulfilment of the promise made by many slaveowners in Cuba, to send to the Government a project of abolition, according to official telegrams of the 2nd and 15th of July, 1870.

6. That there constantly appear in the official *Gazette* of Porto Rico concessions of freedom made by masters to their slaves in that island. The number of slaves existing there, in 1868, was 43,361; but has now been reduced by voluntary manumission to 30,041.

7. That the insurrection of Cuba has produced the dispersion or death of two-thirds of the slaves of the Central and Eastern Departments of the island, who, in 1862, amounted to nearly 180,000 persons.

8. That, according to official declarations, the base of the Cuban insurrection at present is formed of slaves and Chinese vagabonds.

Considering, therefore—1. That "slavery is an outrage on human nature and a stain on the only nation in the civilised world which retains it," according to the eloquent and manly declaration of the Revolutionary Junta of Madrid, on the 15th of October, 1868. 2. That slavery is utterly incomprehensible in the dominions of a people who, like the Spaniards, procuring for themselves and by themselves the Constitution of 1869, have recognised the existence of the natural and inherent rights of man. 3. That as often as our Antilles have been consulted on the subject, numerous Spaniards there have proposed to the mother country the abolition of slavery, as is proved by the reports of the commissioners of 1866, and the projects presented and sustained by the Porto Rico deputies in all the Cortes to which they have been called. 4. That the question of slavery being a question of the rights of man, the ministers and representatives of the great free peoples of the world have protested against it, and against the conduct of the Spanish Government; and there has at this moment been initiated abroad a grand movement of public opinion against our attitude, the results of which we ought to foresee, and the disgrace of which we ought not to incur. 5. That the ill result of the Preparatory Law of 1870 does not cause surprise to those who know the history of emancipation, where it has proved that measures of that nature have always failed, and the legislators have had to accord new and radical ones like that of immediate abolition, as happened in Jamaica, in St. Thomas, in the French colonies, and as at this moment is happening in Brazil. 6. That the abolition of slavery at this present time would be highly politic towards ending the insurrection in Cuba, while its delay may help the resistance, as happened in 1793 and 1804, in the island of Santo Domingo. The undersigned therefore pray the Senate to proceed to the discussion and votation of a definite law for the immediate abolition of slavery in Cuba and Porto Rico.

CURIOUS RESULT OBTAINED IN THE MICROSCOPIC EXAMINATION OF A CANE SOIL.

By Dr. T. L. Phipson, F.C.S., &c.

On submitting to a careful microscopic examination the residue left by the prolonged washing of a cane soil from Barbados, a most curious fact revealed itself which will, I have no doubt, interest the readers of this journal.

The soil in question is one of a series recently analysed in my laboratory, it was one of the redder kinds, and a surface soil. I was duly informed that it had been limed, by the numerous small nodules and grains of chalk which it contained throughout; but I was rather anxious to know whether it had been recently treated with Peruvian guano, and I therefore carefully washed it, collected the residues of the washings, and, placing them under the microscope sought diligently for some of those beautiful fossil *Diatoms* which are by no means uncommon in Peruvian guano, and whose siliceous or flinty nature renders them almost indestructible.

None of these were found, though a few peculiar forms of lower organisms belonging to the clay itself, were noted.

But no sooner had this examination commenced than I was surprised by the presence in this surface soil, of certain forms which were not only quite new to me, but which, I do not hesitate to affirm, no chemist or microscopist ever met with before.

Seen with a magnifying power of about 200 diameters, these curious bodies appeared more or less globular in shape but, were terminated at one side in an elongated point, and at the opposite side in an abrupt point. They were somewhat in form like an ordinary pear with a long tapering stalk, but some were curved like a retort, whilst others were nearly straight. They were of various sizes, and the largest of them was quite invisible to the naked eye. One of the largest of these curious little bodies had its tail part bifurcated at the extremity, and its thicker or pear-like portion much swollen out.

But the most striking part of their history is, without doubt, that these corpuscles were brilliantly metallic—like polished steel of the finest quality, and a careful examination of them proved that they were indeed microscopic globules of melted iron. Now, as to their origin :—

It is customary in the estate from which these soils were taken to throw megass ashes upon the cane fields, and these microscopic pear-like globules of melted iron were evidently derived from the bars of the fire-places where the cane trash is burnt. The dimensions of theso globules vary from $\frac{1}{80}$th to $\frac{1}{1000}$th of an inch in diameter.

Something practical, in an agricultural point of view may, perhaps, be derived from this unexpected observation. These metallic globules, so brilliant and so minute, had been contained upwards of two years, at least, probably much longer, in this surface soil without undergoing the slightest oxydation. This fact shows how slowly the oxydising action of air and water effects itself in these dense clays, as compared with this action in sand and other porous soils, and consequently that the manure applied to such soils must contain within itself not only material to afford porosity, but a certain amount of oxydising power also.

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COLONEL STEWART'S SULPHUR PROCESS IN DEMERARA.

Colonel Stewart, whose process is being introduced into Demerara, lately delivered a lecture on the subject to an assembly of the leading planters and others interested in the sugar manufacture in the colony. In the course of his address, he said:

Many in this audience will recollect the time when the commerce of the world and the travels of man were carried on between continents by vessels propelled by sails, and when by land the ten-mile-an-hour coach was our express train, even for the transmission of the most important despatches of our business men; but in these days we are blessed with the means of transportation, travel, and the transmission of intelligence, that insures, comfort, shortens time, and practically annihilates space. Should not the sugar-producer remember these facts, especially when it is considered that his vocation confers upon mankind the greatest blessings, cotton excepted, of any branch of agriculture outside of the necessary cereals of life. A quarter of a century ago cane sugar controlled the markets of the world without a rival; at this time, however, it has a most formidable competitor in beet sugar, which should excite the most profound attention of every planter in the cane-producing regions, and especially in this. True when we consider, climate, soil, quality and quantity of saccharine matter are all in favour of cane sugar; indeed, beet sugar may be considered a forced crop, yet, strange to say, its growth has been onward and upward. Last year it amounted to nearly one million of tons, having nearly doubled since 1865. The reason is apparent to the most ordinary comprehension. It is a fact well known, that there is 18 per cent. of sugar in your cane. Of this you realize say 7 per cent., thus entailing a loss of 11 per cent., or nearly two-thirds. It is evident that you have done much in the attempt to remedy this evil; no labour or expense has been spared, so far as mere mechanical means is concerned; in fact, you are far in advance of your neighbours, and your magnificent sugar houses, with their fixtures, may well excite their envy and admiration: but you have not probed the evil. In the extraction of the juice of the beet root, and its fabrication into sugar, science has been exhausted. In cane sugar it is impossible to extract more than 65 per cent. of the juice with a three or even a five-roller mill; hence the efforts to introduce the "Diffusion Process," which appears to have succeeded admirably upon a limited scale, but will scarcely be found practicable upon estates of the magnitude of those in this colony. No matter, however, what per centage of juice is expressed, or the manner in which it is done, your interest prompts you to make it into the best possible grade of sugar. I know it is a favourite argument with many planters that common process sugar pays best, considering the difference in the amount of capital required to produce an article fit to compete with the refiners' product. This in the abstract may be true, but they (the planters) lose sight of the fact that every hogshead of such sugar is equivalent to placing a weapon in the hands of their rivals which will ultimately destroy them. I suppose every gentleman here present is aware, that in order to produce the best mercantile article of sugar, the refiners are compelled to use at least 25 per cent. of cane sugar to mix with that from beet root, thus you enable the refiners to utilise the labour of your enemies, control the sugar market, and in time to force you to submit to any terms they may see fit to dictate, just as the manufacturers of the Northern States of the United States induced the Southern people to confine their attention exclusively to planting, while they supplied them with every description of manufactured articles, from the broom that swept the floor, to the mill that crushed the canes. This continued until they were enabled with their gigantic monopolies to overpower, and almost sweep us from the face of the earth. "Coming events cast their shadows before," and you may infer from our fate what yours may be. I might elaborate this point, but time will not permit. I can only advise you to use every means in your power to increase the quantity and improve the quality of your sugar, until the consumers will prefer a pure cane sugar, to the refiners product, even at the same price: at the same time you must reduce the expense of manufacture to the lowest possible point; with a slight change in your mechanical agents, and by the aid of science, as applied through chemistry, you can succeed, if you only have the will and determination to do so. By the introduction of my process into this colony, I propose to save you thousands of dollars per annum, as compared with the system of clarification by the use of bisulphite of lime. My process is simple in its character, and comparatively inexpensive, and has so improved the quality of Muscovado sugar wherever it has been introduced, that it has excited the opposition of refiners both in Europe and America. When I commenced my career as a sugar planter, lime was the only agent used in the sugar houses, for you must recall to mind that sugar chemistry was in its infancy at that day; indeed, I may say that it is only within the past 25 years that we have any practical evidence that the sugar producer derived any material benefit from it. In 1810 Proust conceived the idea, that in sulphur there existed a perfect clarifier of cane juice; this view was subsequently elaborated by a large number of distinguished scientists, and we can but admire the persistency with which they toiled for more than 30 years to apply this agent. It is true their efforts were unsuccessful; their researches, however, enabled Professor Melsens to discover that valuable agent of which you all know something—bisulphite of lime—which superseded sulphate of alumina, and all other clarifying agents used in Louisiana, and stood without a rival until 1858, when I succeeded in applying sulphurous gas to cane juice by dissemination, which has not only driven bisulphite of lime, but animal charcoal, from every district where I have introduced it. Bisulphite of lime, was made by Professor J. Melsens, by the introduction of the fumes of sulphur into lime water as a base. There are various modes of manufacturing this agent, but none has ever been found to equal that originally introduced by the distinguished Professor. To argue that bisulphite of lime is as pure as sulphurous gas, is to say that the stream that passes through the drift of the earth, is as pure as at the fountain head.

All admit that the only valuable quality in bisulphite is the sulphurous property, and so impressed with this truth was Professor Melsens, that he expressed the hope that some person would follow in his footsteps and discover a means of applying it direct to cane juice. This discovery I made, as I can prove to the perfect satisfaction of any person or persons, and have introduced it into more than 1,000 sugar houses, with the most gratifying results. At *Leonora* the same success has crowned my efforts, for the details of which I will only refer you to the report of the Hon. William Russell, to whom I am greatly indebted, and to whom I wish to express my gratitude for his invaluable services. I do not consider it necessary to enter into an argument to prove its value chemically, as he has exhausted the subject from the mill to the sugar hogshead, and made it plain to the most ordinary understanding. If, however, any gentleman requires further testimony, it will afford me pleasure to submit analyses, made by those eminent English chemists, Deyton, Wallace, and Wodehouse, at the instance of Messrs. Scott, Simpson, and Wallace, of London, and also one by that celebrated Swedish chemist, Justo Hjalmaason, who, for his scientific attainments has been Knighted by His Majesty the King of Sweden, is a Grand Master of Berzelius, &c., &c.

The sugars made at *Leonora* by my process polarized 98 without washing, and by washing 150lbs., using only one pint of water, it polarized 100. I challenge any refiner in the world to produce a better result. This process was patented by me in the United States as first discoverer in 1859, (January 11), and in every part of the world that I have visited since that day, I have come in contact with persons who claimed to have been the original discoverers of my application of sulphurous gas. Dr. Icery, of Mauritius, has made a name of world wide fame, in the discovery of what he terms monosulphite. The Doctor has been Knighted and decorated in honour of his grand discovery, and he has given evidence of his appreciation of these royal favours by continuing to wear them, after having been charged through the public press by honourable and disinterested gentlemen with having appropriated my discovery to himself, but inasmuch as you are unacquainted with the gentlemen who so charged him, it would not be proper to enter a verdict against him, but fortunately for me I hold in my hand a succinct statement of the monosulphite of lime process (see *The Sugar Cane*, for 1870, pages 86 and 166) and also an engraving of the apparatus for the application of sulphurous gas, which is the reliable agent in his process, all others being catch-traps to cover his infringement. And now I place side by side with it a drawing of the apparatus patented to me by the United States Government in 1859, bearing the great seal of that Government, which you will observe was issued many years before he even claims to have made the discovery. It is upon this testimony that I rest my claim, and submit the question whether Dr. Icery merits the honours he wears as the fruits of his own labour, or whether he has appropriated that which of right belongs to me?" Now, let us take a look at another gentleman, Dr. Seyfurth, as we find in the pages of *The Sugar Cane*, of May, 1871, where he claims to have applied sulphurous gas to syrups in vacuum pans, and states that he patented his process September 10th, 1869, or more than ten years after I had made the application on my estate, "*Oaklawn*," eleven miles below New Orleans, and for which I took out a patent as before stated. I have also made this application of the gas to syrups in the Wetzel revolving pan, on the estate of the Hon. Luchitti, in the Island of Porto Rico, but experience has led me to believe that the best manner of applying sulphurous gas is to cane juice as it comes from the mill; but my patent covers both methods. A variety of reports are in circulation regarding the cost of the apparatus and royalty for the use of my process. I propose a comparison between it and the bisulphite of lime, and if I err I earnestly desire to be set right. In conversation with planters and merchants, I learn that estates in this colony use a-half per cent. of bisulphite of lime, or an average of at least ten gallons to the hogshead of sugar, which would amount on a crop of 1,400 hogsheads to 2,240 dols. annually, or 31,360 dols. in fourteen years, to say nothing of freight, casks, &c. By my process the cost is as follows, on an estate making 1,400 hogsheads:—

	dols.
Cost of machine, 500 dols., at 10 per cent. per annum for 14 years	700
Royalty for 14 years	4200
Sulphur for 14 years, 3lbs. to hogshead	1764
	6664

thus saving 24,696 dols. in 14 years.

I have fixed the Royalty payments as follows, viz. :—

⅓ cash on erection of the machine in the sugar house,

⅓ in twelve months, and

⅓ in eighteen months.

These figures I guarantee. But, gentlemen, we are told that it requires great skill and intelligence to work the process. If this were true, I confess I have seen no country better able to supply that intelligence and skill than this colony, where the planters are certainly far in advance of all others I have had the fortune to meet; but such is the simplicity of the system that a labourer possessing ordinary intelligence can learn to work it in one day. Now, gentlemen, I wish to make a short statement concerning a point which I am aware deeply interests you all, and that is regarding the molasses. Many prominent gentlemen connected with the refineries have written against my process. I especially remember that Mr. J. V. Onativia, a respectable merchant, of New York, writing to parties in Porto Rico, advised them not to adopt the Stewart process, as it had ruined the sugars and molasses of Demerara. This was in 1870. He certainly displayed great ignorance concerning the process, as at that time it was not known in this colony at all, nor until within the last month. Since writing those letters Mr. Onativia has had substantial reasons for changing his opinions; his partners in Porto Rico, the great house of Lattimer & Co., are in fact one of the heaviest purchasers in that island of both the sugar and molasses, and prefer it to all other descriptions. The molasses has always commanded the highest market price, and sells in the island at an average of 35 cents. per gallon. In the United States it sells only second to the molasses of Louisiana, where my process has been at work ever since it was patented, and when I assure you that the sugars sell equal to

Demerara crystals, you will readily believe that it must be of very superior quality.

The following letter from Mr. Russell was then read:—

LEONORA, AUGUST, 1872.

COL. STEWART,

DEAR SIR,—You are aware that I had made considerable researches in connection with the use of sulphurous acid as an agent to be used directly in the clarification of cane juice, instead of the roundabout system now in use, and known as bisulphite of lime, before Colonel True made my acquaintance here, and the moment he showed me the revolving churn, I gained the missing link which was wanting to enable me to carry out on a large scale what I had already done on a small.

It may not be out of place for me to recapitulate a few of the reasons which induced me to try and use the sulphurous acid instead of the bisulphite of lime, as it is well known the last-named compound has been the principle cause in bringing up the Demerara sugars to their present excellence.

1st. The wasteful process by which the bisulphite is made must always tell against its use, for to begin with its manufacture, we have to burn the sulphur in combination with nitre to form sulphuric acid; this acid has to be again distilled, in connection with some substance, to extract its extra equivalent of oxygen, thereby reconverting it into sulphurous gas; this gas is passed into whitening and water, and the lime in this mixture acts as a base, and lays hold of the acid, converting the mixture into the bisulphite of every day use, which can be stored in wooden casks for a time, but even those soon get destroyed, from the corrosive action of the liquid.

2nd. The transport of such a bulky article, and the loss from leakage, amount to a considerable sum.

3rd. Knowing that it is the active principle of the sulphur which acts upon the cane juice in the way of a decolourizer and anti-ferment, and that the lime in the form in which it is combined with the acid, does more harm than good in the manufacture of sugar, I naturally concluded that the end might be gained at once from the sulphur fumes being incorporated with the cane juice; for as it is well known that water, at a temperature of 75° Faht., takes up 32 volumes of the gas, it stands to reason that the watery parts of the cane juice would act in a similar manner, saying nothing of the gas that would enter into combination with the colouring, and other nitrogenous matter contained in the solution.

4th. In my researches among various authors, I came across several recommendations of sulphurous gas. So long ago as July, 1847, Dr. Scoffern found out the wonderful preservative qualities of sulphurous acid; for after stating that "there are certain acids, which, under no circumstances that I have been able to recognise, are injurious to the constitution of sugar," he adds, "of these the carbonic and sulphurous acids may be cited. The latter has long been known as a powerful anti-ferment; and taking advantage of this property, I was enabled to obtain a specimen of cane juice from the island of Barbados, in a state of such complete conservation, that I extracted from it upwards of 20 per cent. of sugar."

I was also aware that the Doctor had patented a process by which, with the use of this gas, he was enabled to precipitate the acetates of lead from the sugar solutions, but as far as I could learn, he never applied it to cane juice in the first instance as a defecant.

I might cite several authorities who have written in great praise of sulphurous acid gas as a powerful antiseptic, and among the latest is Dr. Dewar, of Kirkcaldy, who was led from one test to another, until he found that the use of sulphurous acid fumes did more in arresting the ravages of the cattle plague than all the other remedies put together, and that such is its preservative qualities, that if a joint of meat be submitted to a daily fumigation, it may be kept fit for use for many weeks. With such facts as these before me, you can understand why I was so ready to take up your process. And now for the trial.

In the early part of July, the different parts of your apparatus were erected, and a trial was made, when it was found that Colonel True had under-estimated the size of churn necessary to disseminate the gas through such a body of cane juice as was sent through the pipe leading from this mill to the clarifiers (from 1,700 to 2,000 gallons per hour). You then arrived on the spot, and at once had a much larger churn made. This again gave trouble, on account of the juice being forced through the long length of piping, instead of by gravitation. Hence a back lash of juice was thrown up the paddles of the churn, causing the whole to get into a whirl, and throwing such a strain upon the working of the machine, that the band could not be kept on the pulleys. When I saw the state of affairs, I had the pipe raised at the mill, giving sufficient fall so that the juice gravitated to the clarifiers. This enabled you to regulate the dip of the paddles to any depth necessary, and all went well.

From the numerous delays, it became necessary to send part of the *Leonora* canes to be ground at *Anna Catharina*, and to cause me to be careful in giving out cane cutting, so as not to have too much cane on hand. The consequence was, that when we got fairly to work, I had to get a mixed lot of canes, partly from both estates, rendering it impossible to give the number of gallons of cane juice with polariscope indications from each field, which is unfortunate, as I had fully intended to have had such indications most carefully recorded, for the sake of comparison. As it is now, I can only give the rough indications—90,000 gallons of juice from rank plant canes indicated 78 by direct polarization, and 211,700 gallons of juice from ratoons gave 87 to 90, so that on the whole the cane juice must be considered poor; and such I expected it to be at this season of the year.

My first object was to find out whether Dr. Scoffern was correct in saying that sulphurous acid has no injurious effect on cane sugar. With this view I had the juice carefully caught at the mill bed, and again after being acted upon by the gas, and, tried with Twaddle's Saccharometer, I found the cane juice from the mill indicated 10·6875, whereas the sample, after being acted upon by the fumes, showed exactly 10·6500. I at once took it for granted that this told against the gas. But upon subjecting both samples to the same treatment with the acetate of lead, and submitting them to the polariscope test, they gave exactly the same indications—90. This juice in being inverted with hydrochloric acid, gave a mean per centage of 87 per cent., and again in both instances they agreed to a line. I now burned double the sulphur, and gave the juice all it could possibly take up, and the result was exactly the same, so that this satisfied me upon the most important part of the investigations, and that is, *that cane juice cannot be made to take up sulphurous fumes to injure its saccharine forming constituents.*

I now made careful trials on the small scale, to ascertain the difference between bisulphite and the gas as decolourizers, and I found that when burning 15 ounces of sulphur to 700 gals. of juice, the decolourizing effect was equal to 2 per cent. of bisulphite, and you know ½ per cent. is generally used.

To satisfy myself that the boy in charge of the furnace could regulate the quantity of sulphur consumed to any required weight, I had a spoonful gauged, which held 4 ozs. of sulphur, and by regulating the supply of injection steam, he was enabled to burn from two to eight spoons per clarifier of juice; (700 gals.) and so expert had he become, that when he saw a punt of suspicious canes with water pickings, he added an extra spoonful to that clarifier. I found that the rank plant canes took as high as eight spoonfuls, or 32 ozs. to the clarifier, or 6 lbs. per hhd., whereas the ratoons gave quite as clear a result from four spoonfuls, or 3 lbs. per hhd.; and I think that for the greater part of the year 3 lbs. will be found to be ample.

You are aware that liming after the juice had been subjected to the fumes gave us some trouble, as we had been accustomed to lime after bisulphite, and knowing the nature of the cane juice from the different pieces, we knew what they used to take. Hence the long time taken to arrive at the proper mark. I might have discovered the cause sooner, but had so many things to think about, that it escaped me. Now I know exactly how to apportion the lime, and that is from ¼ to ⅓ more than when bisulphite is used, and I believe it is owing to this fact that the gas is so much superior to the sulphite, for when you come to think that the difference between the quantities required arises from the bisulphite having in its composition a quantity of chalk, which equals ¼ to ⅛ of the temper lime required, the cause is apparent, and I do not think that any manufacturer of sugar would go to his temper lime cask for ¾ lb. of his temper, and the chalk barrel for the other ¼ lb. It is true you can get quite as good a clarification and neutralization with chalk or building lime as with the best temper lime, but when the syrup comes to granulate, then the difference is found out, and that crispness which is imparted to the mass by the caustic lime, (and which property I have never been able to discover the action of) is entirely wanting in syrups treated with common lime or chalk. They on the contrary present a stringy, slimy appearance and feel, and give a much larger proportion of molasses.

I have often found the difference between making good and bad sugar due to the quality of lime being used, and I have no doubt every practical man can endorse this; such being my experience, I give it as my opinion without hesitation, that this excess of temper lime required is one of the strongest reasons why the gas is superior to the bisulphite.

The working of the cane juice on the battery was simply magnificent, and although I have often seen the *Leonora* batteries at certain seasons of the year come up to the appearance due to the gas, I have never seen such juice as we had to do with from the plant canes anything like it, and I believe every one who saw the working of the walls (batteries) were delighted with them.

The syrup was taken off the walls at 20° Baumé, and after twenty hours time the precipitation was so perfect, that the syrup in being drawn into the vacuum pan exactly resembled champagne.

To test the preservative qualities of the acid, I had two goblets filled with cane juice, the one acted upon by gas, and the other not. The colours were quite different when first put into the goblets, the one being a pale milky white, and the other a dark greenish grey. The following morning they were both the same colour, the goblet with pure cane juice having formed sufficient acetic acid to act upon it in the same way that the gas had upon the other sample. By taste, the one was quite acid, and the other sweet. By the following morning, (48 hours) the pure juice was fermenting, and that which had been subjected to the gas had a slight film on the top, and had just turned slightly.

A long test glass has remained filled with the syrup as it was being taken up into the vacuum pan ten days ago, and it is now just showing the first incipient stage of fermentation. These are clear proofs of the anti-ferment qualities of the gas.

The working of the syrup under vacuo was perfect, crystallizing very rapidly and quite free, and without any colouring matter, made a very fine sugar, very similar to what is made in the French usines after the use of animal charcoal, and with a slight application of water in the centrifugals became nearly equal to loaf sugar in colour. Such being the rage for yellow sugar, that to meet this taste different colouring agents have to be employed, such as a small application of sulphuric acid to the sugar in mass, or a washing with syrup, into which one gallon of caramel to twenty of syrup at 30° Baume has been added, which produces the yellow so much prized, thus in a measure assimilating the colouring of our pure sugar to the same as our prize rum. Should the taste of the consumer become educated to appreciate pure white sugar, and the Chancellor of the Exchequer give his assistance in the same direction, we should have no difficulty in supplying an article equal to loaf sugar in appearance, and very much richer in saccharine qualities.

I made several tests of the sugar with the polariscope, and found direct reading of from 96 to 98 with yellow sugars, and after inversion from 94 to 96½, and with the white sugar the readings were exactly the same as with sugar candy, and such was the purity of this sugar that the standard solution of 16·350 grammes of sugar to 100 of water did not require any purifying agent to enable me to test it in the polariscope.

It may interest you to have the working of the cane juice from two estates both under my charge, and upon the same coast, viz., *Leonora* and *Tuschen de Vrienden*, the manufacture being conducted upon the same principles in both cases:—

LEONORA. (Gas)

	Gals. Juice.	Lbs. wet Sugar.	Lbs. per gal.	Dry Sugar.
February	464,000	781,200	1·68	476,694
April	330,800	699,720	2·10	424,278
June	351,225	561,750	1·60	434,039
July	194,250	291,480	1·50	178,830
July and August ..	301,700	422,520	1·40	256,743
		Average..........	1·68.	

TUSCHEN DE VRIENDEN (Bisulphite).

February	253,800	411,516	1·62
April	81,400	140,758	1·72
April and May	61,800	110,880	1·80
May..............	87,100	132,608	1·50
June	130,200	179,298	1·37
July and August ..	136,800	192,976	1·40
		Average..........	1·55.

These results come pretty close together considering the large quantity operated upon, and you will see that last grinding gives exactly the same result on both estates. This would indicate that they have done as well at

Tuschen de Vrienden with bisulphite as we did with the gas. I am bound to admit that you were put at the disadvantage with the rank plants against all ratoons at the other place. Again the difference in the quality of the sugar is decidedly on your side.

Your grinding may be summed up thus: 301,700 gals. cane juice yielded 422,520 lbs. green sugar, and shipped 138 hhds., equal to 256,743 lbs. dry sugar, all in English pounds, and gave an offal crop of 11,811 gals. of molasses, being 85 gals. molasses to the hhd., and 2,186 gals. cane juice to the hhd.—a result with which I am entirely satisfied, when the quality of the juice is taken into account, especially considering that as high as 3,000 gals. to the hhd. has been recorded on some estates this month.

I am now in the act of removing the apparatus to a more convenient position, and the small apparatus which was considered too small for here (which I now question), is about being put up at *Tuschen*, so that I hope to be in a position to work out your system to the greatest perfection, when I get to work in October, and at the same time I am quite satisfied with the result, so far as we have gone. We have yet experiments to make and information to gain, which will enable us to exceed the working now recorded, quite as much as the gas has exceeded the results gained from bisulphite; and if any one is doubtful about the difference, let him compare the 14 hhds. made with bisulphite after your drum got out of order, with the 41 hhds. made from the same juice by your process, and I think he will be convinced. The sugars will be put up at the Rooms; Gas Nos. 848 to 888, Bisulphite 889 to 902.

As I have already said, the same Coolie lad who attended to the bisulphite does all the manual labour in connection with your process. The power exerted by the engine equalled 3-horse power for the very large apparatus, but I think you may safely calculate from 1 to 2 horse power as ample for riving a medium sized machine, and I recommend you to put all your machines in a convenient position so as to take the juice direct from the mill, subject it to the gas, and then return to the pump cistern; arrange the cover of the box (Churn) in such a way that by counter-balance weight it may be removed at a moment's notice either for repairs or cleaning out after a long grinding.

I sum up the difference of cost between your system and bisulphite, thus:—

Apparatus complete, 1,200 dols.

	dols.
Interest and Tear and Wear	120 00
Sulphur for 1,500 hhds at 3 lbs.	135 00
Royalty, 1,500 at 3 dols. 4500÷14	321 00
	576 00

Bisulphite.

3,000,000 gallons Cane juice, divided by 700, equal to 4,286, multiplied by 4 equal to 17,144 gals. of Bisulphite at 16 cents..	2743 04
Transport of 171 Casks both ways	171 00
	2214 04

Trusting that I have made myself sufficiently clear, and that you may be able to put the information to some practical use.

I am, yours faithfully,
(Signed) William Russell.

ON THE INFLUENCE OF FORESTS ON RAINFALL.

By Alfred Fryer.

(Continued from page 536.)

From an article, in *The Times,* on the disastrous floods which have lately been devastating some parts of Italy, the following forcible passage, pointing out their causes and remedy, is extracted:—

"Unfortunately, although it is the plain that suffers, it is the mountain that is at fault, and there the evil has been growing for centuries and is now almost altogether past remedy. The volume of water which pours down from the Alps and Appenines was probably at all times the same; though it may be that when the mountains were mantled all over with wood, the moisture was more constant, the rain more frequent and consequently less violent. So long also as the upper region was a mass of green, the rain, or the melted snow, was trapped as it were by the roots, the trunks, and the fuller foliage of the trees. It had to trickle and struggle through endless obstacles, and its downward flow was in some measure broken; what came down was only, or at least mainly water, and it found its way to the sea through unobstructed channels. But for the last four or five hundred years, the Italians, like the Provençals, the Spaniards, like all the people along the shores of the Mediterranean, have been stripping the mountains of their primeval forests without dreaming of replanting them, and the result has been a general crumbling down of the soil, leaving the rock bare and bleak with deep scars and seams, everywhere marking the path of the landslip and the ravine. The evil, as we have said, is already of ancient date; but it has assumed enormous proportions since highroads and railways have made the deepest recesses in the mountains accessible to the woodman's axe; and the demand for timber and for fuel for steamers and railway engines, has only too amply rewarded his destructive labours. The injury done to the plain in Italy, however grievous, is not irreparable, so long as it can be kept within certain limits; for the deposits of the mountain streams are not irreclaimably barren, and a few years care is sufficient to cover them with fresh green, and obliterate every trace of their ravages. But the wear and tear of the plain is tremendous, and there is always the danger that the destruction may get the better of all human energy and perseverance, for, wherever the water is allowed to spread at large and stagnate, not only the flooded surface, but the whole region for miles around is apt to generate malaria, and risks a relapse into that swampy condition from which Roman enterprise rescued it. Three or four years of incessant flood would render vast tracts of beautiful Lombardy as unhealthy and desolate as the Tuscan or Pontine marshes are now, and other strips of maritime territory all along the coasts of the peninsula, and of the islands of Sardinia and Corsica. The disasters of the plain, as we have stated, have their origin on the mountains. However arduous the task may be, whatever amount of time, care, and capital may have to be expended upon it, the Italians must rescue their country from the ravages it suffered from the hands of their forefathers; they must reconstruct, and as it were recreate their mountains, by replanting and protecting those forests which their forefathers and themselves ruthlessly destroyed."

THE RAINFALL OF MAURITIUS:—A paper on this subject by Mr. C. Meldrum, in the proceedings of the Meteorological Society, Vol. IV., No. 38, besides bearing on the subject of Forest and Rainfall, is of so generally interesting and valuable a character, that, with the exception of some of the tables being condensed, it is transferred almost entire to this article.

"Mauritius is situated nearly between 20° and 21° S. lat. and 57° and 58° E. long. It is somewhat oval or pear-shaped, its northern being narrower than its southern extremity, and its greatest length from north to south being thirty-five miles, whilst its greatest width from east to west is twenty-nine miles. From its most northern to its most southern point the distance is thirty-nine miles, and from its most eastern to its most western point thirty-five miles. It has a superficies of about 720 square miles, and is divided into nine districts, viz., Rivière du Rempart, and Pamplemousses, extending from coast to coast in the north; Port Louis, on the west coast, south of Pamplemousses; Flacq, on the east coast, south of Rivière du Rempart; Plaines Wilhelms and Moka, the latter lying wholly, and the former almost wholly in the interior;

Black River, on the west coast, west of Plaines Wilhelms; Grand Port, on the east and south-east coasts; and Savenne, on the south coast."

"The principal feature in the conformation of the island is, that it consists of a central table-land, which is separated from the plains on and near the coast, in some places by lofty mountains, in others by steep precipices, and in others by more gradual, but still rapid, descents. This table-land occupies nearly the whole of Moka and Plaines Wilhelms, together with the more inland parts of Flacq, Grand Port, Savanne, and Black River. Its central ridge, which is the principal watershed of the island, extends in an east-by-north direction, from the Savanne mountains in the south to the northern limits of Moka, over a distance of about twenty miles, and, like the table-land itself, is most elevated in the southern half. From this ridge the ground slopes on either side, forming here and there, at heights of 700 to 1400 feet above the sea level, extensive and almost level plains which, in some places, are abruptly separated from the littoral plains, several hundreds of feet below them by almost perpendicular cliffs. The more gradual ascent in the intervals between the mountains, commences at short distances from the sea, and continues up to heights of 1200 to 1800 feet, from which there is a similar descent to the opposite coast. The railway from Port Louis on the west to Mahébourg on the east coast, crosses the table-land in the direction of N. W. to S. E., and the heights of the stations, determined by levelling, show the ascent and descent in that part of the island. Thus, at four miles from Port Louis, the elevation is 392 feet; at eight miles, 923 feet; at eleven miles, 1311 feet; and at sixteen miles, or about half-way, 1822 feet; the line then descends to 1000 feet at twelve miles, 559 feet at seven miles, and 253 feet five miles from Mahébourg. Generally, however, the table-land is separated from the littoral plains, or the sea, by mountains, of which there are three groups, viz.:—

"(1.) The Port Louis group, in the north-west, the central line of which runs about twelve miles in an east-by-north direction, at four to eight miles from the sea, and which ranges from 1000 to 2900 feet in height."

"(2.) The Black River and Savanne group consisting of a series of mountains and elevated ridges, from 1000 to 3000 feet above the sea-level, stretching irregularly about twenty miles to the southward, along the west coast, and then about fourteen miles along the south coast, the greatest distance from the sea not exceeding six miles, while in many places the bases of the mountains or steep cliffs are close to the shore."

"(3.) The Grand Port and Flacq group, in the east and south-east, rising to the height of 1200 to 2400 feet, and consisting of three main chains running nearly parallel to one another in a westerly direction, the principal chain being about fourteen miles long."

"Most of the main chains send off branches, which form a succession of valleys and gorges opening towards the sea. The upper portions of the mountains and elevated ridges are generally composed of bare rock, presenting here and there the appearance of lofty cones, peaks, turrets, and serrated ramparts."

"Between the bases of the mountains and the sea there are, more or less, all round the island, low-lying and nearly level plains. Rivière du Rempart and Pamplemousses, north of the Port Louis mountains and portions of Flacq, are, comparatively one extensive plain, the greatest elevation attained by the railway which passes through them being only 329 feet, at a distance of six miles from the sea."

"The island is drained by a great many rivers and streams, the largest of which take their rise on the table-land receiving in their courses numerous tributaries from the mountains, and, as they flow onward through deep wooded ravines, forming in some places picturesque waterfalls. They all vary in volume according to the season, and occasionally some of them become quite dry."

"Both in the interior and near the coast there are lakes, marshes, and swamps. The principal of these are the Grand Bassin, in Savanne, at an elevation of 2000 feet and covering a superficies of thirty to forty acres; the Marc aux Vakois, on the confines of Plaines Wilhelms and Black River, about 1900 feet above the sea level, and having an area of about 1200 acres, the Marc aux Lubines, and others in the lowlands of Flacq, a number of marshes in the lower parts of Grand Port, and several ponds, swamps, and marshes near the sea in Black River and in the neighbourhood of Port Louis. It need scarcely be remarked that the volume of water in these lakes and marshes varies with the rainfall."

"The island is of basaltic formation, and the soil in many places is highly ferruginous. The surface of the ground is usually covered with loose stones; but here and there, particularly on the table-land, there are tracts of free soil, many feet deep, in which no stones occur, and in other places patches of solid *sheet-rock* as flat as a paved floor. Deep ravines and subterranean caverns abound in various parts."

"At one time nearly the whole island was covered with dense forests, which, within the last twenty years, have been greatly diminished. Of the 432,000 acres forming the entire superficies of the island, it is estimated that there are still 80,000 acres of forest in a more or less dilapidated state, 150,000 acres in cultivation (chiefly under the sugar cane), 110,000 acres in pasture, and the remainder in rock, river, and mountain."

"Particulars of the nine stations at which the observations summarized in the two tables below were taken:—

STATIONS.	Height above Sea Level.	Distance from East Coast.	Distance from West Coast	Height of Gauge above Grnd	Sort of Gauge.	Periods of Observation	
	Feet.	Miles.	Miles.			Yrs.	Mths
Mont Choisy	50	7	½	..	..	5	0
Les Rochers....	180	8	4	..	..	5	0
Lucia..........	500	5	8	8 inches	Glaisher	5	0
Labourdonnais..	200	5	6	..	..	5	0
Port Louis	47	16	..	40	10 × 20	8	0
Gros Cailloux	130	23	2	8 inches	Glaisher	5	0
Beau Séjour....	930	19	6	"	"	5	0
The Braes......	1250	19	7	"	"	5	0
Cluny	960	6	16	"	"	5	0

"*Annual march of the Rainfall.*—Since rainfall depends upon evaporation, and evaporation upon temperature, we should expect to find in an island like Mauritius a close connection between the rainfall and the temperature; and the tables show that such a connection exists. Thus, from Table I. (p. 646), which gives the results of six years observation (1853-58,) on the ground, at Port Louis, we find that the rainfall increases 0·5 inches in September to 9·3 inches in February, and that with the exception of a small increase in June, it decreases from February to September."

"During the next eight years (1859-66,) the observations at Port Louis were taken at the Observatory, about 400 yards east of the former station, and at 40 feet above the ground, and the results which are given in Table II (p. 656), show a similar progression. In place, however, of a tendency to a second maximum in June, we find a small but well marked second maximum in August. From September to February the mean rainfall increases from 0·4 inches to 13·5 inches, from which it decreases to 0·8 inches in June; it then increases to 2·1 inches in August, from which it falls to 0·4 inches in September."

"Turning now to Table III (p. 647), which shows the results of five years observations in different parts of the island, we find an exactly similar march, both for each station and for all the stations taken collectively. Over the parts of the island represented by the gauges, the rainfall increases from 2·0 inches in September to 12·9 inches in February; it afterwards decreases to 2·8 inches in June; it again increases to 4·9 inches in August and then falls to 2·0 inches in September."

Table I.—*Rainfall at Port Louis, from January, 1853, to December, 1858, inclusive, on the ground, and about 8 feet above sea level.*

YEARS.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Means.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1853 ..	4·4	5·8	4·5	5·9	6·8	8·1	0·8	0·9	0·7	0·5	0·7	0·6	39·8
1854 ..	4·1	10·9	3·7	12·1	1·3	0·9	0·7	0·3	0·1	0·6	0·5	4·0	39·4
1855 ..	6·7	17·4	8·2	2·1	0·6	2·4	0·8	1·1	0·6	0·5	1·3	1·1	42·7
1856 ..	0·7	10·5	10·5	3·5	2·3	0·3	0·9	0·7	0·1	1·9	5·2	9·5	46·2
1857 ..	13·5	7·6	6·4	2·4	0·2	0·9	0·7	0·4	0·9	0·6	4·4	5·5	43·4
1858 ..	13·4	3·7	3·5	3·1	1·3	1·1	1·1	0·7	0·6	0·8	1·8	4·2	35·3
Means..	7·1	9·3	6·1	4·8	2·1	2·3	0·8	0·7	0·5	0 8	2·3	4·1	41·1

Table II.—*Rainfall at Port Louis, from January, 1859, to December, 1866, inclusive, at 40 feet above the ground, and about 47 feet above the sea level.*

YEARS.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Means.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1859 ..	2·3	8·2	7·9	5·9	6·5	0·9	0·6	3·2	0·2	1·3	0·0	7·2	44·3
1860 ..	14·7	13·6	7·6	1·3	1·3	0·4	0·8	2·2	0·4	0·5	0·2	2·3	45·2
1861 ..	5·4	46·6	2·5	3·2	3·7	0·9	0·4	1·8	0·0	0·1	2·2	2·0	68·7
1862 ..	4·0	4·7	5·9	1·8	6·8	0·6	0·6	1·0	0·3	0·6	0·8	1·1	28·4
1863 ..	9·5	10·9	3·4	1·5	0·7	1·7	0·7	0·3	0·7	1·2	0·4	2·4	33·4
1864 ..	2·3	5·8	2·9	1·9	0·5	0·3	1·5	3·9	0·4	0·8	1·9	1·8	24·1
1865 ..	3·3	15·5	3·2	0·8	0·2	0·8	2·4	3·3	0·6	0·8	1·8	12·1	44·7
1866 ..	5·4	2·5	3·8	4·8	1·2	0·4	0·4	0·7	0·4	0·2	0·0	0·8	20·6
Means..	5·8	13·5	4·7	2·6	2·6	0·8	0·9	2·1	0·4	0·7	0·9	3·7	38·7

Mean Monthly and Mean Annual Rainfall, at Nine Stations in Mauritius, derived from Five Years' Observations (1862-66).

STATIONS.	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Means.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
Mont Choisy	8·8	12·2	5·8	2·8	4·3	1·8	2·2	4·3	1·4	1·4	0·9	5·6	51·5
Les Rochers	8·9	10·6	6·9	3·5	3·7	1·7	2·3	3·1	1·5	1·4	1·1	5·1	50·1
Lucia	8·7	12·3	7·9	5·0	5·0	2·8	4·0	6·2	1·9	2·4	3·3	8·3	67·9
Labourdonnais	11·3	12·3	7·3	4·0	5·5	2·7	3·6	4·5	1·7	2·1	2·1	6·5	63·6
Port Louis	4·9	7·9	3·9	2·2	1·9	0·7	1·1	1·9	0·5	0·7	0·9	3·6	30·3
Gros Cailloux	4·1	7·6	4·3	1·9	1·9	0·6	0·8	1·9	0·6	0·6	0·7	3·0	28·0
Beau Séjour	9·9	16·2	8·8	4·9	3·3	2·6	3·6	4·4	2·3	2·2	2·8	9·1	71·0
The Braes	8·1	15·5	9·4	6·1	2·5	2·9	3·2	4·3	3·0	1·8	2·9	7·9	67·7
Cluny	15·2	21·4	18·6	12·8	8·2	8·1	10·1	13·5	5·1	6·0	6·4	17·3	142·8
Means	8·9	12·9	8·1	4·8	4·0	2·8	3·4	4·9	2·0	2·1	2·4	7·4	63·7

Annual Rainfall at Nine Stations, in Mauritius, from 1862 to 1866 inclusive.

YEARS.	Pamplemonsses.			Rivi're du R'part	Port Louis.	Black River.	Plaines Wilhelms.		Grand Port.	Means.
	Mont Choisy 50 feet.	Les Roches, 180 feet.	Lucia, 500 feet.	Labourd'ais, 200 feet.	Observatory, 47 feet.	Gros Cailloux 130 feet.	Beau Sejour 930 feet.	The Bracs. 1250 feet.	Cluny, 930 feet.	
	Ins.	Ins.	Ins.	Ins.	Ins	Ins.	Ins.	Ins.	Ins.	Ins.
1862	41·6	41·8	60·7	52·2	28·4	25·3	69·1	59·5	122·5	55·7
1863	54·7	61·3	67·9	70·7	33·4	33·3	99·8	81·1	147·1	72·5
1864	48·9	42·7	57·9	57·2	24·1	24·2	54·6	70·6	122·5	55·9
1865	67·5	60·9	101·6	87·6	44·7	36·6	87·1	78·8	192·4	84·1
1866	45·0	40·8	51·8	50·3	20·6	20·7	44·5	48·7	129·4	50·2
Means	51·5	50·1	67·9	63·6	30·3	28·0	71·0	67·7	142·8	63·7

"Generally, therefore, the annual march of the rainfall of Mauritius, presents a double progression, having two maxima, in February and August, and two minima, in June and September. From September to January (the warmest month,) the rainfall increases with the temperature, and attains its principal maximum in February, and from February to June it decreases with the temperature. Instead, however, of decreasing with the temperature in July (the coldest month,) it increases, and continues increasing till August, when it has a second maximum before attaining its principal maximum in September."

"It would thus appear that notwithstanding the diminished evaporation in winter, (temperature being regarded as the principal agent,) the low temperature of July and August causes a more copious precipitation than takes place, with a higher temperature and greater evaporation in May and June; or, it may be, that the increase of rain in July and August is partly due to an accelerated rate of evaporation, in consequence of the strong and dry trade wind, which then agitates the surface-waters of the surrounding ocean."

"An examination of the monthly observations, for each year, will show that the annual march is subject to considerable fluctuation. Thus, during the fourteen years' observation at Port Louis, January was the rainiest month *four* times, February *six* times, and March, April, May, and June *once* each. A similar but smaller fluctuation occurred in the epochs of the other turning points."

"At other stations during the five years 1862-66 similar fluctuations occurred."

"These fluctuations are partly due to revolving storms, which are attended with torrents of rain, to the action of opposite winds (either general, like the S. E. trade wind and N. W. monsoon, or produced locally by the heated land and rocks,) in forcing vapour up the sides of the mountains, and to thunderstorms, which, however, are often referable to the same causes. On six days in February, 1861, for example, during a hurricane, 47·73 inches of rain fell at Port Louis; the consequence was that not only was February the rainiest month, which it ought to have been without the hurricane, but that the fall for the year far exceeded the mean annual fall. Again, during a thunderstorm in the night of the 24th to the 25th of May, 1862, 3·245 inches of rain fell at Port Louis, and greater amounts at other stations, so that in several parts of the island, May was the rainiest month in that year."

(To be continued.)

NEW METHOD OF CONCENTRATION IN CUBA.

A correspondent in Cuba states that a new apparatus is on trial there for the concentration of cane juice, which the inventor, a Mr. Sanchez, calls "a machine for making sugar without molasses." In principle it is similar to the tray in Fryer's Concretor, the concentration being performed by passing the juice from the mill over surfaces of metal. In Mr. Sanchez's machine there are several surfaces or trays placed one above another and heated by steam; the juice flows from one to another in the process of concentration, whilst a blast of cold air passes continuously over it to prevent *ebullition* (which Mr. Sanchez says is the cause of the formation of molasses). Between the first and second surfaces, the juice is passed through a layer of animal charcoal to decolorize it. Sugar is produced by the process similar to concrete, and polarizing 90 per cent. being dry.

A correspondent of one of the Cuban papers points out that Mr. Sanchez's invention (?) has no claim to originality, the principle of trays or surfaces being the same as in Mr. Fryer's Concretor, and the idea of the blast of cold air being due to Mr. Leonard Wray.

SUGAR BEET CULTIVATION.

At the Lavenham Farmers' Club, Mr. Duncan, the proprietor of the sugar factory in the town, said:—"It was anticipated that the yield all over Europe would amount this year to a million of tons of sugar, whereas a few years ago it was only 300,000. The quantity of roots which would be required to produce that amount would be 18,000,000 tons; which, at an average of one-fifth, would also produce 3,600,000 tons of pulp for feeding cattle. Taking the worth of the pulp at 12s. per ton, that would be £2,160,000. The value of the sugar he had put at £27 per ton, which would be twenty-seven millions. In addition there was a large quantity of molasses, which might be valued at £800,000. Thus there was an aggregate amount of £29,960,000, or close upon thirty millions of produce from the sugar beet all over the continent. It seemed to him very strange that England should have allowed this industry to go past her entirely. As far as they could see, every day it seemed to make more rapid strides. The quality of the roots had been completely settled. They could grow roots in this country far better than in France, better than in Belgium, and quite equal to Holland. He had received a quantity of roots this year from Buscot, in Berkshire, which had given by analysis 15·95, or nearly 16 per cent. of sugar. The best roots that could be grown on the continent he had never known to exceed that. That showed clearly that the soil in this country was adapted for the growth of beet root. He also argued that the growth of sugar beet and the manufacture of the sugar were beneficial to a farm. In the south of France, where a sugar factory was built, the land and the farming was very good, but about ten miles from that, where there was no sugar factory, there was a different class of farming, and everything was poor. The reason was they had no manure. If they had no market for the roots, they only served for feed, but if they had a sugar factory they would produce a large quantity of pulp after having been there; the cattle must be kept some time or other, the manure must be made, and the manure made corn. Corn and beet root would thrive together. Wherever they had a beet root sugar factory, it was well known that the land would double and treble its value. The growth of corn had been immensely increased, and the amount of cattle produced on the land had been increased also. This season, the farmers had very large crops of roots of all kinds, and plenty of hay, and all food stuffs were cheap. The great advantage of the pulp from the sugar beet was that there was no necessity to use it the same year it was made. They could keep it, and it would be very much better for food another year. At the present time he had a lot of bullocks eating the pulp of roots grown in 1868, and manufactured in 1869. He considered that new pulp was not nearly so good as pulp that had been kept for some time and matured. Sugar pulp that had been kept was more soluble in the stomachs of the oxen, whereas new pulp was harder and more indigestible."

THE COOLIE QUESTION IN JAMAICA.

Some months ago there appeared in *The Sugar Cane* a series of resolutions which had been adopted at Meetings of the Planters in Jamaica, and laid before the Government, in favour of a revision of the laws relating to Coolie and other emigrants. A Select Committee was appointed to consider these resolutions, and their Report, as laid before the Legislative Council, has been forwarded to us by our Jamaica correspondent; but its publication has unavoidably been delayed.

After referring to the main points dwelt upon by the Petitioners, the Report thus continues:—

"With respect to the growing disposition on the part of the native labourers in the agricultural districts to withdraw their services from estate's work, and to the insufficiency of the supply of native labour to keep in cultivation the present area of land under cane culture, both which points are pressed with much urgency by the petitioners, the Committee have to ask attention to the Report of the Commissioners appointed in 1867 to enquire into the system of Coolie Immigration from India to this island, which was presented to the Board in the month of October of that year. On these two points the Commissioners wrote thus:—

" 'The desire which the Creoles have constantly shown since the abolition of slavery to make themselves independent of employment on estates by purchasing and cultivating land on their own account has been so generally realized that the number remaining in sugar-growing districts is quite inadequate to supply that continuous labour which is required, more especially as they generally retire to the cultivation of their own plantations at the time when favourable seasons render their services necessary for the planter.

" 'It appears clear, therefore, that no dependence can be placed in future on the Creole population of this island to support the cultivation of estates, and that without an immediate importation of other labourers it will be imposible to maintain even the present low standard of exports, upon the increase of which the material interests of the Colony largely depend.

" 'The adoption of the Coolie immigration for labourers upon an extended scale appears the only alternative to relieve the agricultural interests from this position, and to benefit the island generally.'

" On the next point urged by the petitioners that all classes participate in the advantages consequent on the introduction of indentured labour, it is unnecessary for the Committee to dwell, as they are not aware that there is any difference of opinion on the point that the community at large cannot fail to derive advantage from the creation and circulation of wealth through the extension of cultivation.

" The Committee now approach the last and most important point submitted for their consideration, viz.: on whom the cost of the introdction of indentured labour should fall?

" The producers of articles of export have been held, whether they employ indentured immigrants or not, to benefit in some measure by the immigration system, even in regard to the first five years of the immigrant's residence, and there can be no question that all producers of articles of export benefit equally by the system, so far as the last five years of the immigrant's residence are conserned, when he becomes a free labourer; and it was by these considerations, it may be assumed, that the Legislature of the island was guided when it appropriated the export duties solely for the purposes of immigration, and this opinion, so far as producers of sugar and rum are concerned, was referred to in 1869, when the last measure, dealing with immigration matters, Law 34 of 1869, was placed on the Council table.

" Since the passing of Law 17 of 1868 the charges heretofore borne by the general revenue under the Act 22 Vic., cap. 1, for the maintenance of the immigrant's colonization and return passage fund, have been defrayed from the moneys belonging to the immigration fund, and at the present time no portion of the expenses connected with the Immigration Department is defrayed from general revenue.

"The revenue for immigration purposes consists of receipts from the export duties, the capitation fees, payments by employers of Coolies for the maintenance of sick Coolies in Union Hospitals, and the proportion of rent charged on employers of Coolies for the Union Hospitals. These receipts, for the present financial year, may be taken in round numbers at £30,000. The expenditure on the other hand for departmental expenses—Union Hospitals and Depôt, Medical Attendance, return passage, and colonization fund, and interest on the Immigration Loans may, in the present financial year, be put at an amount very little short of £29,000; so that there can be said to be nothing really available from the present financial years' Immigration Revenue for the cost of the introduction of further immigrants. Had the number indented for in this season been supplied, the costs of their introduction would have been fully £48,000.

"Under the powers given in the 22nd Vic. cap. 3, 'An Act for Raising Funds to Defray the Expenses Attendant on the Introduction of Immigrants into this Island,' the Governor is authorised to raise by loan in any one year a sum not exceeding £50,000, but the aggregate of the moneys to be thus borrowed is limited to £150,000; already £36,000 has been raised under the statute, and £10,000 will have to be borrowed for the expenditure incurred in the present year for the introduction of East Indian immigrants. In the ensuing year, should the number applied for (three thousand) be supplied, the cost of their introduction will not be under £60,000, and to meet this call recourse will be necessary to the full extent of the borrowing powers under the Act.

"It is therefore evident that the power of borrowing under this Act will be ere very long exhausted, and together with the failure of the funds to continue the introduction of immigrant labour, will also assuredly arise a deficiency in the immigration revenues in meeting the current charges for the maintenance of the immigration system, and whatever that deficiency may be, the general revenue stands pledged to supply.

"This point deserves serious consideration, and should be taken into account when dealing with the question of supplementing the revenue for immigration purposes by further receipts to be drawn from the general revenues of the colony. And in connection with this subject, it should be remembered that employers of immigrant labour receive now indirectly no small advantages from this guarantee of the general revenue, both in the rate of interest at which the moneys for immigration purposes have been raised, and also from the circumstance that in the absence of any such guarantee these moneys could only be raised on such personal security as they might have to offer.

"While, therefore, general revenue contributes at present indirectly, and at no very distant day, should the demand for this class of labour remain as at present, will have to contribute directly to the expenses of immigration, the Committee cannot but admit that much weight attaches to the argument of the petitioners that the Coolie immigrants who elect to settle in the island add materially to the stability of the colony, by the permanent addition given thereby to the labouring portion of the population. There are, at the present moment, as many as 2292 unindentured Coolies employed on estates where there are indentured Coolies, the sub-agents not having access to ths other estates are unable to state the total of the number so employed in the island.

"From a recent return of the Acting Agent General of Immigration it would appear that about one-third of the Coolies entitled to return passages elect to return to India, the other two-thirds electing to remain as permanent settlers in the colony. Taking this average for his guide, the Acting Agent General assumes that between 1872 and 1882 the number of Coolies likely to accept the bounty and remain in the colony, will be four thousand three hundred, and allowing the rate of bounty at twelve pounds ahead, there will be required, in the course of the next ten years for bounty money, the sum of £51,600; and the Committee are prepared to support the petitioners thus far in the memorials they have presented, that the bounty payable to Coolie immigrants who elect to settle in the island be defrayed out of the public funds.

"When the present powers of raising monies for the introduction of immigrant labor under the existing statues are exhausted, the contribution to the Immigration Fund necessarily to be made from general revenues will not be inconsiderable, and in the present uncertainty as to the extent of that contribution, as also to the uncertainty whether the demand for immigrants, fitful aud irregular as it has hitherto been in this colony, will continue as at present, more especially when the cost to the employer cannot fail to be higher than at present, and when also the price of the staple articles of export may chance to be lower, the Committee are not prepared, under prayer of the petitioners, that the cost of the introduction of labour be further lessened to the employer of that labour, at the expense of the public, than to the extent they have already reccommended in the report now submitted."

BARBADOS.

The weather since the beginning of the month has been all that the planters could wish. The rain has been heavy and continuous, almost every night a heavy shower, with no great wash. It will do much for those estates where there is still hope of a crop, but there are many who have not even a hope of the sort, such a trying season we have had. These are mostly the estates on the sea coast, from East point in St. Philip round by the light-house, and all along the Leeward coast in St. James, St. Peter, and St. Lucy, to the Cove. The last two parishes and the southern part of St. Philip have suffered most severely, the rainfall to the present being less than thirty inches. In the Central District in part of St. George's and in St. Thomas, and on the highlands, the crops are low but vigorous, and if the rains keep up, a fair return may be looked for.—*The West Indian.*

NEW PETRIFYING SILICATE PAINTS.

By the general introduction of these new paints white lead bids fair to be permanently superseded for many purposes to which it has hitherto been exclusively applied. In the first place they are cheaper, always an important consideration; in the second place, the peculiar form of silica which they contain renders the surface of any object covered with them indestructible, causing the substance of the paint to petrify. From their non-chemical action upon metals they afford thorough protection to iron ships, whether they happen to be submerged or not. This should be good news to Mr. Goschen and his subordinates at the Admiralty. Even already the authorities are trying the new compound, the example of the Milwall Dock Engineering Company having been followed by the Indian Government Dock-yards, Austrian Lloyd's, Trinity Board, Egyptian Government, and other public Companies. For once, then, red-tape and circumlocution have not been allowed to obstruct a valuable improvement. The paint tested when dry contains 94 per cent. of pure silica. Mr. G. N. Williams, Halecliffe, Warrington, writing in November last, says, "I put two coats on a piece of wood, and the same on a piece of iron. When dry these were put into the pan of strong chloride of calcium, which was gradually raised to the boiling point 240° to 250°. It was kept at this heat for about three hours, and then cooled down. A day or two afterwards they were again exposed to the same process, and though the paint has lost its brightness it seems quite uninjured." So much for its capacity to stand heat without blistering. The Liverpool Assay Office bears this unequivocal testimony, that "the paints made with this substance will stand any climate, and we believe them to be superior in all respects to white lead." Accordingly, we may anticipate that the resources of the Silicate Paint Company, who enjoy the sole right to work the mineral deposit in North Wales, will soon be over-taxed to supply the demand. The same manufacturers have adapted the material to household uses, the principal of which is the cure of damp walls by a covering of a solution of silica, which is free from water-glass and renders impervious to weather all kinds of brick, cement stucco, and masonry. Not in shipbuilding alone, therefore, but also in domestic comfort, this new agent will assert its beneficient powers.—*British Trade Journal.*

Correspondence.

Berlin, 24th November, 1872.

To the Editor of "The Sugar Cane."

Sir,

Observing that the use of the Concretor as an adjunct to the vacuum pan has lately been mentioned in *The Sugar Cane*, I thought that some particulars of my opinion of its use in this connection may be of interest to your readers.

My Concretor is of the L size, and has been at work since the spring, 1869, on my estate in Salvador, Central America, concentrating cane juice to a syrup of about 30° B. for the vacuum pan, and I find that the megass from about 3500 gallons of juice is required to concentrate 8000 gallons from 10½° B. to 30° B. The quantity of juice that the Concretor will so concentrate is about 1000 gallons per hour. The Concretor has to be kept very clean and the megass used has to be very dry. The syrup obtained by the Concretor is in quality far superior to that concentrated in open pans.

I am, Sir,
Yours respectfully,
Fr. Bogen.

COLONIAL EXPORTS.

(From Licht's Monthly Circular.)

MAURITIUS.

From 1st Aug. to 17th Sept.	1872. Tons.	1871. Tons.	1870. Tons.
To England	4,229	5,114	611
,, France	3,796	1,898	438
,, Australia	5,570	3,692	2,432
,, New Zealand	615	223	354
,, Cape of Good Hope	164	—	183
,, Bombay	—	4,752	5,209
,, Other Ports	4	799	123
Total	14,378	16,478	9,350

HAVANA AND MATANZAS.

From 1st Jan. to 4th Oct.	1872. Tons.	1871. Tons.	1870. Tons.
To Great Britain	139,361	62,866	173,815
,, United States	197,510	163,744	171,370
,, Spain	35,407	44,060	57,247
,, France	21,835	11,080	43,960
,, Northern Europe	12,679	8,315	10,195
,, Southern Europe	960	547	3,410
,, Other Ports	4,921	3,069	8,045
Total	412,673	293,681	468,042
Stocks in Havana and Matanzas	44,247	50,847	33,332

BAHIA.

1st Oct. to 30th Sept.	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.	1868-69. Tons.
To Europe	43,561	45,340	30,346	35,604
,, United States	774	817	608	3,890
,, The La Plata	122	490	23	600
,, Africa	—	12	8	4
	44,457	46,659	30,985	40,098
From Perambuco	90,000	48,351	73,592	72,750
Together from Brazil	134,457	95,010	104,577	113,848

STOCKS OF SUGAR IN THE CHIEF MARKETS OF THE WORLD ON THE 1ST OCTOBER FOR THREE YEARS, IN THOUSANDS OF TONS, TO THE NEAREST THOUSAND.

	1872.	1871.	1870.
Great Britain	176	145	186
France	39	28	29
Holland	31	35	30
Germany (Zollverein)	3	3	9
Six other *entrepôts*	7	5	4
Total in Europe	256	216	258
United States	87	115	107
Havana and Matanzas, 4th Oct.	44	51	33
TOTAL	387	382	398

CONSUMPTION OF SUGAR IN EUROPE AND THE UNITED STATES, FOR THREE YEARS ENDING 30TH SEPTEMBER IN THOUSANDS OF TONS.

	1872.	1871.	1870.
Great Britain	695	681	687
France	250	283	312
Germany (Zollverein)	211	211	210
Holland	27	22	31
Six other Countries	88	116	109
Total in Europe	1,271	1,313	1,349
United States	581	501	470
TOTAL	1,852	1,814	1,819

ESTIMATED CROP OF BEET ROOT SUGAR ON THE CONTINENT OF EUROPE, FOR THE ENSUING SEASON, COMPARED WITH THAT OF THE THREE PREVIOUS SEASONS.

(From Licht's Monthly Circular.)

	1872-73. Tons.	1871-72. Tons.	1870-71. Tons.	1869-70. Tons.
France	350,000	335,351	289,084	289,324
Germany (Zollverein)	265,000	189,166	262,986	217,192
Austro-Hungary	175,000	161,526	182,280	151,354
Russia and Poland	135,000	90,000	135,000	132,500
Belgium	80,000	72,236	55,739	43,552
Holland and other Countries	35,000	25,000	17,500	12,500
Total	1,040,000	873,279	942,589	846,422

SUGAR STATISTICS—GREAT BRITAIN.

To 16th November, 1872 and 1871. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.	London.	Liverpool	Bristol.	Clyde.	Total, 1872.	Total, 1871.
British West India	24	2	2	22	50	34	84	12	13	58	167	201	72	11	12	41	137	189
British East India	8	2	..	..	10	14	17	7	..	..	24	10	12	8	..	..	20	22
Mauritius	4	1	..	..	5	7	16	5	14	8	43	20	14	4	15	10	44	17
Cuba	6	2	1	15	24	14	8	14	25	67	114	54	6	13	24	58	101	50
Porto Rico, &c. ..	3	3	..	2	9	6	5	19	1	8	33	26	4	17	1	7	28	27
Manilla & Java ..	15	4	..	4	23	22	28	13	2	14	56	43	26	18	2	9	56	62
Brazil	2	13	..	5	20	16	8	49	9	21	88	57	7	44	10	21	82	56
Beetroot, &c.	3	2	1	3	9	7	19	10	6	37	71	127	21	11	6	38	76	128
Total, 1872 ..	64	28	5	52	149	112	185	129	70	212	596	531	161	127	71	185	543	553
Total, 1871 ..	52	25	4	30	37 increase		180	106	55	191	65 increase		197	113	55	188	10 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

During the past month the market on the whole has been firm, and though the amount of business done has not been very extensive, yet imports having continued to slacken, prices of most descriptions have been fully maintained.

Stocks have decreased considerably during the month, but not more than the average at this season; there is still nearly the same excess over those of last year as a month ago. Imports show a rather greater comparative increase, having reached 65,000 tons above those of 1871, and 30,000 tons above those of 1870, to the same date. Deliveries present a slight proportionate increase during the month.

In the better classes of raw sugars there is little variation in price, but in good Bahias and Pernambucos there appears to be some improvement. No. 12 Havana and No. 12 Mauritius afloat are quoted at 28s. 6d. to 28s. 9d.; good Cuba Muscovados 25s. 6d. to 26s., fully 2s. 6d. per cwt. lower than prices at same date in 1871. Middling to good Bahias are worth 21s. 6d. to 22s. 6d.; and good to fine Pernambucos 23s. 6d. to 24s. 6d. The average duty paid price of refining qualities of British plantation is 29s. Common refined lump is quoted at 39s. 6d. to 40s. per cwt. in London.

The greatly increased consumption, and reduced stocks in the United States has led to a considerable demand for sugars for that market, to which, it is said, that some floating cargoes have been despatched from this country.

The continental beet-sugar manufacture is in full progress, and the production of the season bids fair to reach the expectations of the most sanguine. M. Licht has again raised his estimate to above one million of tons, and the *Journal des Fabricants* mentions 325,000 tons as a figure which may easily be surpassed in France. Favourable accounts continue to be received of the coming crops in Cuba, and some other countries; on the other hand, from Mauritius and Reunion the yield of sugar is, owing to violent rains, likely to be somewhat less than was anticipated.